The Blast Furnace and Steel Plant

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Industrial Training Schools

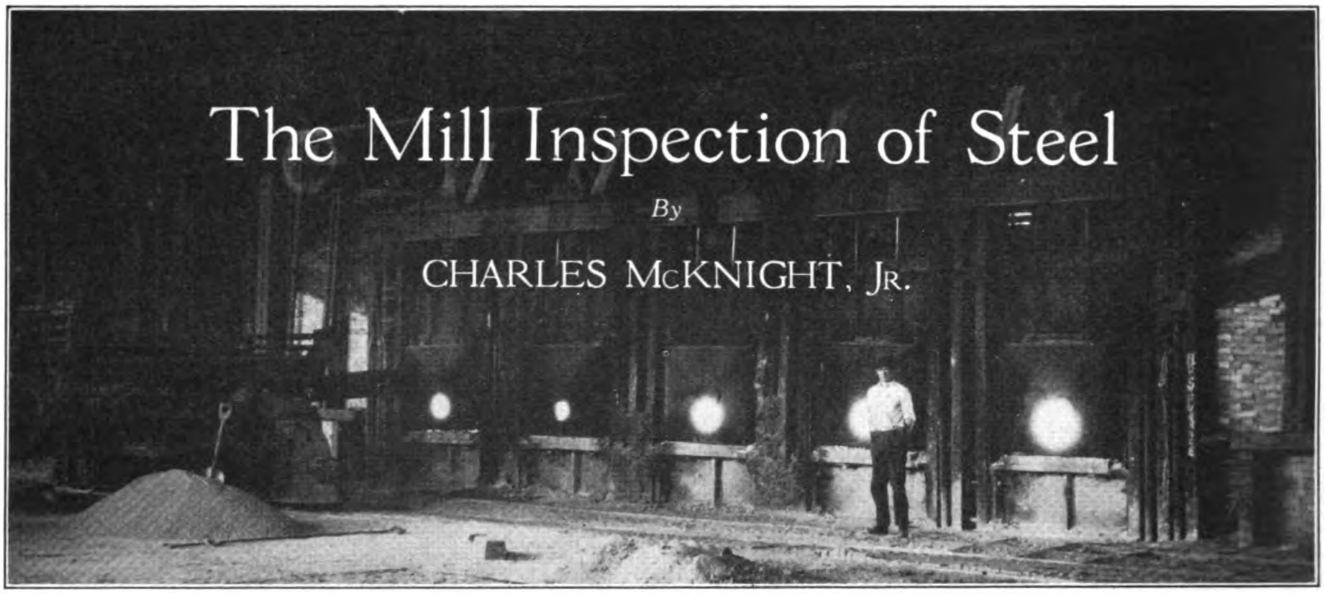
AMERICAN industry has educated young men at the expense of the employers long enough to obtain a general idea of results. Training classes are now conducted as an optional auxiliary by many establishments outside of shop hours, and much benefit has been derived by the employees, chiefly young men. It requires several years to cover the courses, and the students, although what they produce is negligible and wholly incidental to their training, are paid a living wage.

The course is generally an intensive one, but it is not altogether technical, for attention is also given to such subjects as will broaden the employees' vision. The yearly cost to the company reaches a substantial figure, therefore, this practice has been looked upon by some with doubt, as they believe the same results could be secured if the men were absorbed in the organization in the general way. Experience has shown that this is not the case, for those who have put this plan into practice, though without exact data upon which to base an estimate of the cost, know that the outlay for schools is a good investment, already having obtained results that are promising for the future.

For a number of years, a school of this kind has been conducted in a large industrial plant where the products are always finding new uses and are made to meet the customers' requirements. The graduates of high schools, trade and engineering schools are offered a three years' course with pay. The entire working day is devoted to the class room, drafting room, and laboratory and to studies of the different production and sales departments. Thus the students are given a general idea of the practical side of manufacturing and of the method of running the business.

After graduation, the young men are located in the shop, sales or engineering department, according to their ability and ambition. The chief purpose of the school is to prepare men for shop executive positions, and for the sales department. Sales training is probably the more important, and the school is maintained to give the men an opportunity of entering the sales department from the shop, which is considered the best possible road.

The salesman must be able to do more than just make a round of his route, trying to secure new customers and holding on to hold ones. He must be energetic and know his product and its possibilities down to the raw material from which it is manufactured. When establishing a new product in a customer's plant, he should be a teacher, and in case any complaints arise, be able to render service. When he comes in contact with problems which he cannot solve, he should have the ability to correctly convey the necessary information to the engineering department for solution.



The Mill Inspection of Steel

By

CHARLES McKNIGHT, Jr.

By definition, inspection is the act of holding a careful, critical investigation. Unfortunately—or perhaps fortunately for our peace of mind—when inspecting steel it is impossible to make absolutely certain of the quality of steel without destroying it. But by careful inspection of product and control of processes it is possible to foretell with reasonable accuracy the quality and performance of a certain heat of steel. It is the duty and the function of the inspector to make the careful, critical investigation called for and cull out that which will not be suitable.

Though simple by definition, the position of inspector is one that requires technical skill, good judgment and a fundamental knowledge of the manufacture and uses of steel. It is also important that he should have the ability to work in an efficient, peaceful way with the mill operating force, and this requires a high degree of tact and diplomacy. The inspector is always in the unenviable and unappreciated position of umpire, either between the operating department and the specifications, so to speak, or actually between the manufacturer and the purchaser of the steel. In addition, an inspector is called upon to use his discretion to an unusual extent and his most valuable characteristic will generally be a supply of good common sense.

The inspection of steel may be that performed by the manufacturer or by the user. As a general rule, it may be stated that the inspection by any reputable mill is of more value than that done by the purchaser or user, because more information is available to the former and it is to his best interests to have no rejections by the purchaser. It is often far cheaper for the manufacturer to scrap and remelt an entire heat than it is to let it get out in the trade and become "commuting" steel—commuting back and forth between the mill, customer and scrap heap—and, therefore, the relation of the inspector to the metal is best expressed by "Merton of the Movies" in his characterization of his wife as "his best pal and, at the same time, his severest critic."

The inspection department, besides being one of the most important in a mill, is also an expensive one, the figures from a mill engaged in the manufacture of high-grade alloy and tool steels showing that this concern, having a relatively small output of about 7,500 tons per month, pays for control and inspection a total of about $4,000 per month. In a larger plant the number of men employed by the chemical, metallurgical and inspection department is well over 50.

In order to present a clear picture of the methods of inspection and the function of the inspector, it is preferable to follow the steel in elemental detail through the processes of manufacture and the inspection noted at each stage, rather than to take up each defect and its detection in haphazard manner.

Specifications.

When an order comes from a customer, the specification usually follows the standard form of one of the technical societies, such as the American Society for Testing Materials or the Society of Automotive Engineers, and there are three main requirements. These are the chemical analysis, the physical characteristics—such as elastic limit, ultimate tensile strength, percentage of elongation and reduction of area—and that "the material shall be free from injurious defects and shall have workmanlike finish." The latter brief discretionary clause is bristling with teeth and provides a wide field for discussion through lack of agreement on what constitutes an "injurious defect" or "unworkmanlike finish."

Raw Materials.

The control and inspection thus necessitated begin with the raw materials which enter into the composition of the metal. As these are received they are sampled and analyzed and it sometimes requires rare judgment on the part of the sample boy to select a representative sample, as, for example, to pick out one or two average pieces from a carload of miscellaneous railroad scrap containing everything from old airbrake hose to journal brasses. In spite of this, very accurate results are obtained and a constant check kept on the metals, refractories, fuels and slag materials as they are consumed.

Melting.

During the actual steel making the melter from time to time as the heat progresses takes a small

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Reprinted from Army Ordnance, vol. v, No. 30. Steel mill illustrations used in this article are furnished through the courtesy of the Pittsburgh Crucible Steel Company.

The author is with the International Nickel Company, New York, in the Development and Research Department.

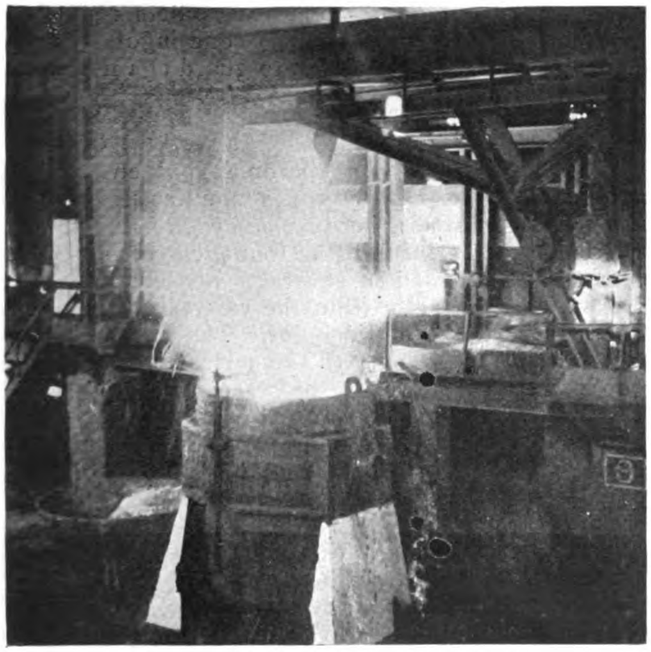
spoonful of metal and pours it into a test mold. This piece is then broken and from the fracture the furnaceman is able to tell the carbon content within a few hundredths of one per cent and whether abnormal amounts of manganese, phosphorus or sulphur are present. Toward the end of the heat, drillings are taken from a similar test piece and sent to the laboratory for a "preliminary" test. In from 10 minutes to a half-hour, depending on the chemist, the carbon and manganese content (and perhaps nickel and chrome) are accurately reported and on the basis of this report the melter finishes his heat, makes the necessary additions and taps out.

Teeming Ingots.

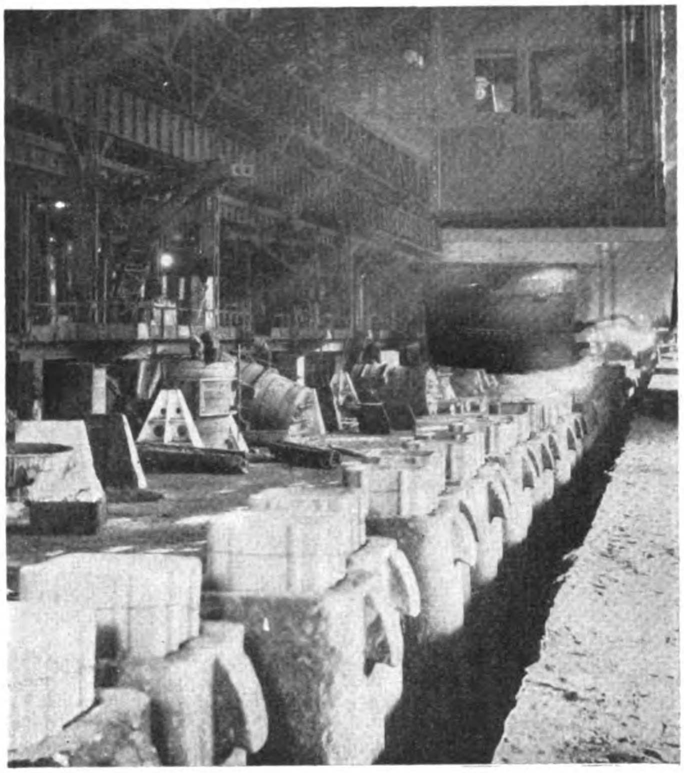
While the steel is being teemed from the ladle to the molds there is no inspection as such, but either the open hearth superintendent or melter watches with care to see that the metal is not teemed too rapidly or too hot, conditions that tend toward cracks and poor ingot structure, and in many plants a check on the temperature is made by means of an optical pyrometer. When the ladle is about half empty the stream is diverted momentarily to fill a small test mold about 1½ inches square by 5 inches long, the ingot from which is drilled and analyzed. This analysis is observed as the official heat analysis and results show remarkably small variations between the composition of this small test piece and the heat as a whole.

The Ingot.

After the ingots have cooled sufficiently, which requires in good practice as long a period as four hours, depending on their size, they are stripped from the molds and inspected for obvious surface defects. If any exist to a detrimental extent, that ingot is scrapped. These defects may arise from many sources, as the time from the tapping of the steel to the stripping of the ingots is the most critical stage in the manufacture of steel. During this stage there become apparent such evils as piping, blowing, segregation, non-metallic inclusions, cracks, ingotism, etc. A few years ago attention was directed at this phase of steel making and there has resulted the general adoption of the sand or tile hot-top to reduce piping, and the big-end-up mold. The combination of the two, provided the mold is also well designed as to thickness of wall, corners and bulge in the sides, represents the farthest advance in that line today. Coincident with this development has come a better understanding of the use of deoxidizing agents, finishing and teeming temperatures, proper ingot cooling, reheating and stripping. Yet even now it is safe to say that the greatest advances in steel making in the near future will have to do with this transitional stage.



Tapping 100-ton open hearth furnace.



Pouring alloy steel ingots.

Ingot Defects.

It is not the province of this article to go extensively into the nature of the defects which result in this phase, but it may not be amiss to at least define and describe them.

> "Piping" is a cone shaped cavity, small end down in the top portion of the ingot which is caused by the contraction of the steel as it solidifies and which varies in size with the type of ingot-mold and condition of the steel. It may exist throughout the greater part of the ingot length or may be almost non-existent.
>
> "Blowholes" are smaller cavities formed by bubbles of gas in the metal and are the main source of seams.
>
> "Non-metallic inclusions," quite generally referred to as "sonims," are particles of dirt, slag, etc., entrapped in the metal and of varying size and frequency of occurrence.
>
> "Cracks," either on the surface or as internal discontinuities, are as often the result of bad or sloppy pouring practice and of contraction of the hot and soft ingot center away from the more rigid exterior as from faulty heating of the ingot preparatory to rolling.
>
> "Scabs" on ingots which later roll into surface irregularities, such as "slivers," are caused by metal splashing during teeming against the cold mold wall where it solidifies and is later incorporated in, but not welded to, the ingot.

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"Segregation" is the term applied to that condition in an ingot which renders it non-uniform in composition. It is influenced by the progressive solidifying of the steel and consequently that portion which is last to freeze shows most segregation. Fortunately, segregation and piping occur to a large extent simultaneously, and are both dealt with by cropping, as outlined later.

"Ingotism" is a peculiar coarse crystalline structure with definite planes of weakness. It may result from either poor mold design or improper teeming or a combination of the two.

A "mold pull" is caused when the ingot is not free to contract in a longitudinal direction, so that the soft metal tears open. It most frequently occurs through "hanging" in the mold, i. e., the metal is held by the hot-top or a lip of steel over th edge of the mold so that the ingot hangs from this point and is torn by its own weight.

Some steels, especially dense and hard, exhibit minute cracks through the center of the ingot. These are usually quite inconspicuous and show up only on an etch test and are obviated only by a combination of good melting and pouring practice, together with careful cooling of both the ingot and blooms, the latter being quite usually buried in ashes to insure slow cooling.

Blooming mill at alloy steel plant.

Soaking.

After stripping, and generally while still hot, the ingots are heated in soaking pits until there is an equalization of heat through the metal and it is hot enough to be rolled in the blooming and billet mills. If the ingots are allowed to grow cold instead of being charged directly into the pits, care must be exercised in order subsequently not to damage the steel by too quick heating. If the steel is alloy or high carbon it is best either to allow the pit to get black before charging a cold ingot or else to preheat the ingots prior to charging in a special furnace for that purpose.

Rolling and Cropping.

The blooming and billet mills rapidly reduce an ingot that is perhaps 20 x 20 in. to a bloom 8 x 8 in., and then to a billet 4 x 4 in. on one heating. None of these dimensions is fixed, as practice varies in different mills. On the completion of this preliminary rolling the billets are removed to the shears, where they are cropped and inspected while still hot. The cropping is done primarily to remove all evidences of pipe, but at the same time it eliminates the segregated portion of the ingot, so it is important that there should be an inspector stationed at the shears to observe this operation. The first cut made is usually about 10 per cent of the total length of the bloom or billet and, if evidences of pipe are still seen, successively smaller cuts are made until it is eliminated. It is easier to judge when it is entirely absent than would be thought, when it is considered that the rolling has tended to make the pipe very inconspicuous. When the shear blade cuts, if there is any pipe in the steel it leaves a small depression, or "lip," on the lower edge of the billet which is unmistakable and almost a sure sign of piping or sponginess. Therefore, the inspector watches the lower edge for freedom from this lip. Unfortunately there is sometimes a condition existing known as "secondary piping," which consists of another and smaller pipe beneath the first and separated from it by a few inches of sound metal. This condition is not common, as it usually results from bad mold design, but when it does exist the shear blade may cut through the solid metal between pipes and give no indication to the inspector of the secondary piping.

If the shear blades are not properly adjusted or if the metal in the center of the billets is spongy, it occasionally happens that the shear drags some of the center out of the billet, producing an artificial pipe somewhere further back in the billet. Like secondary piping, this is difficult to detect, but it may be caught later in the bars. Luckily it does not happen often.

As soon as cropping for pipe is accomplished the billets are cut into convenient length and usually a tail crop is taken. This tail crop amounts to about 5 per cent and is taken to eliminate the possibility of spongy and unsound metal, which is prone to occur at this point. The billets are then given a very close inspection for defects of all sorts, and drillings for analysis are sometimes taken from billets representing the top, middle and bottom of one ingot. This is called the "billet check" and is to guard against excessive segregation.

Seams and Chipping.

The chief defects that become apparent at this stage are seams, especially in the manufacture of alloy and high-grade steels, because they are neither as prevalent or as harmful in the tonnage grades. These seams may be caused in several ways, but the great majority of them arise from the existence of surface, or skin, blowholes in the ingot. The blowholes are formed immediately beneath the surface and when the ingot is stripped, still hot, and placed in the soaking pit, the oxidizing effect is sufficient to remove the outer skin and lay open these holes, the interior of which becomes coated with oxide. If, by any chance, they exist through this heating operation without becoming oxidized, they are opened up in the first rolling operation and exposed to the atmosphere and the same action takes place. In either case the blow hole, not welding together on account of the oxide, is elongated in the same ratio as the steel and consequently appears in the billet—or even in the finished bar—as a long and narrow fissure in the surface. Seams vary in appearance greatly. Sometimes they run the whole length of the billet or bar and at others they are only a quarter-inch or so long. The actual fissure is sometimes open and clear so that the presence of a seam is unmistakable but, on the contrary, it may be covered with scale and open out below the surface, becoming very difficult to locate. No matter what the appearance or where the location is or how small in size, it is essential that all seams be removed either by milling, grinding or chipping with pneumatic hammers before the final rolling process, and this removal is getting to be a very important factor of expense in mills today.

Pickling.

On alloy steels, as well as the steels for some particular purpose, it is becoming general to pickle the billets prior to chipping in a hot solution of sulphuric acid. The advantages are that the troublesome scale is entirely removed before any further hot-working is done and any surface defects, especially seams, are very clearly shown up.

Faults other than seams which are looked for at this time are burned, heavily scaled and torn billets. If the steel has been burned the billet is scrapped, as the metal will be coarse-grained and interlaced with oxide, but heavy scale can be removed by either pickling or chipping. It is rather difficult to describe the difference in appearance between a burnt and a heavily scaled billet, but they are not easily mistaken. If the scale is hit with a hammer and falls off in large plate-like pieces, leaving the metal surface fairly smooth, the billet has not been burnt. When burning has occurred the scale is tight, though heavy, and the e appears to be a zone of merging instead of a clean-cut separation of oxide and metal. Torn or split billets are caused by too heavy reductions in the mill and improperly heated or insufficiently deoxidized steel. They can sometimes be rendered usable by chipping, but must ordinarily be scrapped. Heavy "ragging" or marking of the rolls to ensure gripping the bloom is sometimes responsible for torn steel.

Inspection of Mill Products.

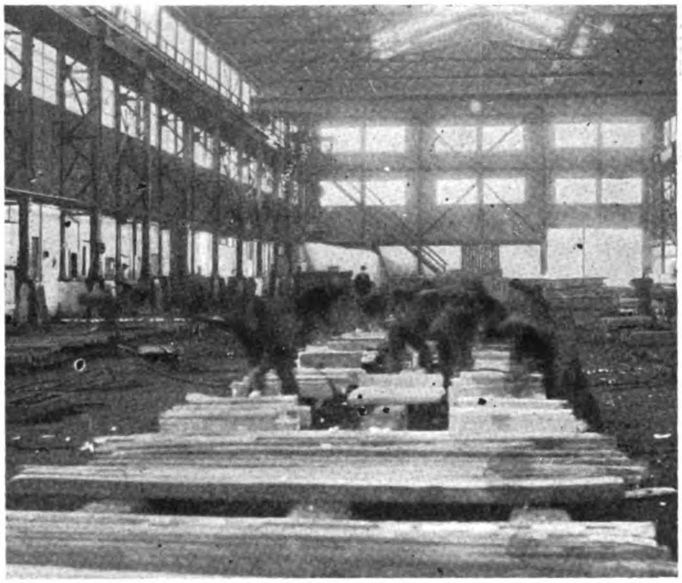
Assuming that the steel in this intermediate stage has been inspected and passed, it next goes to the bar or merchant mills, unless intended for forging purposes. On these mills are rolled the commercial bars used in industry and the number of shapes which can be turned off a good mill is amazing, comprising as it does everything from the simpler rounds, squares and hexagons up to the very intricate special sections. It is here that the inspection is closest and most important. Practice is different in every mill, but as a rule one inspector is close to the mill and is constantly gaging size and watching for faulty steel in order to inform the roller so that he can remedy in time the condition causing it; the other inspector gives a closer and more leisurely inspection, using frequent tests to confirm his observations.

Rolling Tolerances.

In regard to size, the maximum allowable variation is 1/8 inch oversize in rounds from 5 to 8 inches in diameter and the minimum is .007 inch under or oversize in rounds up to 1/2 inch in diameter, and, of course, allowance must be made for the expansion due to heat. This amounts to approximately .015 inch per inch. The inspector on the mill is equipped with micrometer calipers to check the diameter, taking dimensions on rounds in four places: top and bottom, sides, high shoulder and low shoulder. It is possible to distinguish the side of a bar rolled on a guide mill from the top and bottom by the roll markings on the finished scale, which usually show the parting of the rolls fairly clearly, thus indicating the two sides. For checking intricate sections the inspector uses a template or two templates, one being the exact side and the other the allowable oversize. A tape is used for measuring the length and a square to check the perpendicularity of the corners on squares and flats.

Upset Tests.

While the duties of this inspector are important, arduous, and require fast work and constant vigilance, the second inspector is just as important, as he is responsible for the quality of the steel. To determine this, simple but invaluable tests are in use. For the upset test, a short section is taken, heated in a furnace and reduced in length under the hammer from 30 to 60 per cent, finally appearing as a short, squat biscuit. This treatment will invariably show up, if present, seams almost microscopic in character as well as laps, cracks and other similar surface defects. Another of these tests is the forging test, in which a section of steel six inches to a foot in length is heated and drawn out by forging, the bar being revolved about its longitudinal exis. The steel is then nicked and broken and if piping is present in the bar it will be opened up and made perfectly apparent.



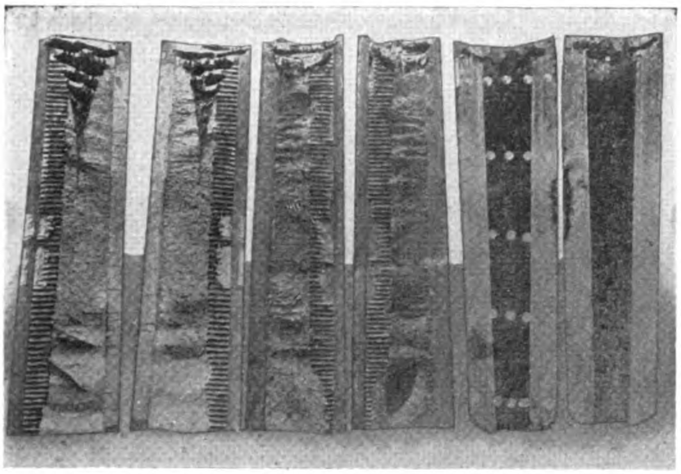
Chipping billets. Prior to rerolling most billets are chipped. Alloy steel billets are usually pickled and chipped.

There are two other tests known as the light pickle and heavy pickle—or simply as the pickle and heavy etch. In the first, a piece of steel is immersed in dilute sulphuric acid a few minutes and the scale removed. The surface and all of its existing defects are then plainly visible. The heavy etch test is a great aid to the inspector and ranks with the upset in value. A short piece is immersed from 10 minutes to several hours in a solution of hot dilute sulphuric acid or a mixture of sulphuric and hydrochloric acids, the action being allowed to proceed until the structure of the metal is plainly resolved. It is then easy to observe if the metal is spongy, piped, cracked or filled with slag fibres.

Rolling Defects.

Besides being responsible for the detection of inferior quality of the metal, this second inspector must finally pass on the surface and general appearance. Some of the defects he must watch for are fins or overfills, underfills, kinky or buckled bars, twists, roll marks, laps, seams, fire cracking, piping, slivers, heavy scale, etc.

A "fin" or an "overfill" is caused either by improper rolling or roll design. In the rolling of steel the metal is formed in grooves cut in the rolls, the groove in the upper and lower rolls which match being known as a "pass." The relation in area between each pass and the preceding and succeeding ones is definite, but if it happens that the ratio of reduction is too great the metal is displaced laterally instead of longitudinally and is squeezed in between the rolls. A bar so marked is said to have a "fin" or "overfill" and the imperfection appears as a slight ridge on both sides of the bar.



Split ingots from different types of molts. (Left)—Ingot from big-end-down, no hot-top (standard) type of mold. The large pipe cavity and area of segregation are very noticeable; the pipe can be detected fully two-thirds of the ingot length. (Center)—Ingot from big-end-down, hot-ton (Bradford) type mold. Cavity much restricted. The Bradford mold had a thick-walled base tapering to top where there was a tile hot-top, surrounded by a charcoal fire. (Right)—Ingot from big-end-up, hot-top (Gathmann) type mold, treated with aluminum mold wash. White spots are locations of analysis drillings.

If a bar finned in an intermediate pass is not caught and allowed to go to the next pass where it is rotated 90 deg. the fin will be rolled down onto or into the bar, but not welded to it and is then known as a "lap."

An "underfill" is the exact opposite of an overfill—there is not enough metal to fill the pass and the section is correspondingly scant.

If the bar is wavy up and down it is "buckled," if sideways it is "kinked"; both of which are usually easily remedied by an adjustment of the rolls. Buckling is sometimes caused by the pinions on the mill which transmit the power intermittently rather than continuously as they should. Also some sections are so heavy on one side and light on the other that they tend to roll off the mill buckler or kinked.

"Fire cracking" is a term applied to a peculiar surface which resembles an alligator skin in appearance and which is produced by a roll, the outside of which has become cracked or "checked" from the heat. This can only be remedied, if serious enough to cause rejection, by using a new pass and then refinishing the roll.

Occasionally through accident, such as letting a tool pass through the mill, an indentation is made in the roll which produces at regular intervals on the section being rolled a similar protuberance, called a "roll mark," and when this is anything more than a slight marking it is cause for rejection. The same principle is made use of in marking structural steel and rails, the maker's name and year being cut into the rolls.

A "sliver" may be caused by burned or badly finished metal, or by improper placing of the guides which lead the bar into each pass of the mill and it is well described by the term.

"Guide scratches" and "tears" which result from improperly adjusted guides or too much manipulation of the steel by the guides are similar in appearance to a seam and many complaints of poor steel or incomplete chipping can be remedied in the guides.

A "cobbled bar," which is rarely seen outside of a steel mill, is really not a defect but a mill tragedy, as the steel instead of running quietly off the mill, winds around the roll and frequently must be laboriously chipped or burned off when cold. If the cobble is not bad, part of billet or bar may be used.

A "twist" is caused by the groove in the upper and lower roll not registering exactly and it is remedied by moving the top of roll endwise in the direction of twist. This is of less importance in rolling rounds than in other shapes.

The defects enumerated above have been given in some detail because they are the principal ones occurring not only in merchant mills, but most other types of mill. Of course, in addition to these each type of mill has its own peculiar defects, but the work on only one other will be taken up briefly.

Plate Mill Products.

After bars the biggest single tonnage of steel goes into plates, comprising 12 per cent of the whole. As is generally known, the mill for manufacturing plates bears very little resemblance to those previously discussed, but usually consists of two extremely large rolls and a third somewhat smaller in diameter. These rolls are 12 feet or more in length, 3 feet in diameter and made of chilled cast iron. Differing from most mills, there are no passes or guides, the diameter of the roll being almost constant, and rolling is done by direct reduction. A modification of this mill known as the universal mill has two or more vertical rolls as well as horizontal rolls and it is possible with this mill to square up the edges of the plate.

On the plate mill the inspector watches for defects before mentioned and in addition for plates which are "laminated," heavy in the center and light on the edges, "snaky," "cambered," "blistered" or "brick marked."

A "laminated" plate shows a marked streaky structure and occasionally at the ends and edges has the appearance of a stack of paper, with leaves separating. It is sometimes possible to wedge these layers apart, just like a pack in sheet mill practice, and such a plate is rejected.

The rolls of a plate mill are machined slightly larger in diameter in the center so that the plate will be the same thickness throughout its width in spite of the spring in the roll and the greater expansion from heat in the center of it. A plate will sometimes be heavier in the center than on the edges, due to wear of the rolls, and this is cause for rejection if it is too marked. Occasionally also the reverse is true and a plate will be heavy on the edges.

A "snaky" plate exhibits marks resembling seams, but they are not confined to a direction parallel with the axis of the plate, as they are in bars, but wind about helter-skelter. It is not definitely known what causes snakes, but it is supposed that they exist through from the ingot and if not too deep or too numerous they are ground out.

A "cambered" plate results from a heavier draught on one side of the mill than on the other, or from unequal heating, so that in rolling one side is extended more than the other. A plate of this sort is usable, but must be sheared into sizes which will fit.

A "blister" is well described by the term and is caused presumably by a blowhole which is not welded up.

A "brickmark" comes from the soaking pits and heating furnaces when a piece of furnace walls or bottom becomes attaches to the metal and is subsequently rolled into the surface. Spalling runner brick are also often to blame.

Laboratory Tests.

While the steel is in process in various departments, the routine work of checking is going on simultaneously. The chemical laboratory as a rule furnishes the complete analysis in less than 24 hours, unless there are some special elements to be determined. The usual analysis includes carbon, manganese, silicon, phosphorus and sulphur. Almost as common are analyses for nickel, chromium and copper, while every steel laboratory nowadays can handle vanadium, molybdenum and tungsten. The work of the chemical laboratory is lacking in spectacular features, but for rapidity and accuracy it is not surpassed by any other department of the mill, and the methods are being improved upon continually. It was not so many years ago that an accurate carbon determination took so long that preliminaries were not thought of and the condition of the bath was judged by eye from the test piece. Now there is a loud complaint from the open hearth if more than half an hour is consumed in drilling the test piece, weighing the sample, heating it up to red heat, burning off the carbon with oxygen, weighing up the products of combustion, calculating the percentage of carbon and being accurate within two hundredths of one per cent.

While on this subject, it should be added that concurrent with the development of the chemical laboratory in the mill has been the growth in specifying steel by analysis so that at present the "temper number" or the "fracture" is rarely heard of as a method of judging steel for purchase, and even the trade name is fast being abandoned in place of the more scientific and logical method.

Physical Tests.

If a physical test is called for, the necessary specimen is taken after final rolling, sometimes by a representative of the purchaser who puts his identifying stamp on it, but more often by the mill inspector. This piece is machined to a standard test piece size and pulled in a tensile machine, the yield point being obtained by the drop of beam method. Concurrently any special tests called for by the customer are taken. These may include the Brinell or scleroscope test for hardness, tests for resistance to corrosion or for permeability (electric steels), for ductility (like the Ericson test), for welding properties and, in addition, impact tests, fatigue tests and combined impact and fatigue tests.

These impact tests include the Charpy and Izod, where a small test piece is broken by the fall of a heavy pendulum and the energy absorbed by the metal calculated. The fatigue tests are varied in character, but in general are simply machines which bend the specimen back and forth, or rotate it under a given load, many thousands or even millions of times until fracture takes place. In the Stanton, or repeated impact, test which is becoming widely used, though it is difficult to interpret the tests, a small grooved test piece is hit a fairly light blow alternately on opposite sides until failure occurs.

One test that is called for a great deal, especially in government work, is the bend test. In this a specimen of the steel is doubled on itself and is usually required to bend cold 180 deg. around a bar whose diameter equals the thickness of the specimen. Sometimes this is modified to require doubling flat on itself or the work is done while hot, to ensure that it is not hot short. This test is considered a failure if the test piece breaks or cracks at the edges of the bend.

Metallographic Examination.

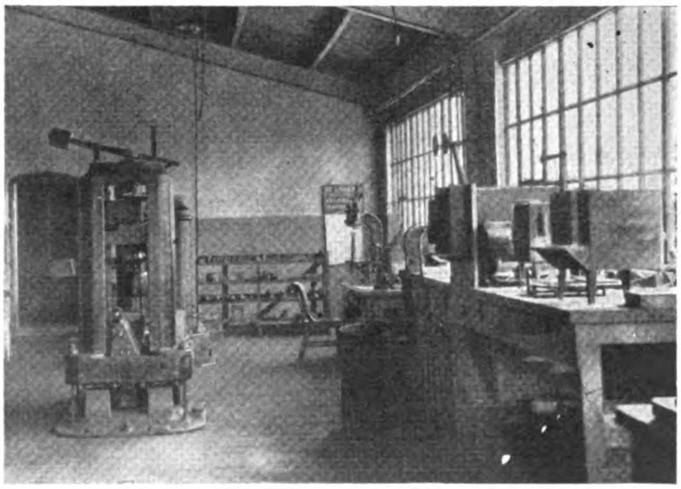
Realizing the importance of the microscope and metallographic work, many mills now require that a representative sample of each heat be polished and examined, both unetched and etched, under the microscope as a matter of routine. This is unquestionably a good thing to do and furnishes a check on the steel if used and interpreted with other tests and is of inestimable value in determining whether or not steel is piped, dirty or full of blowholes, as well as the structural condition.

There is still another method of examination that shows great promise of value. This is the radiographic method of photographing through the steel and locating inclusions and blowholes. It is in process of development now, and recently some valuable data have been published on radiographic examinations of steel castings. However, it is improbable that it will ever be used as a routine method on account of the difficulties, dangers and expense attending the use of the X-ray.

A word of warning to the inspector not to be too hasty to accept or condemn on one test piece will not be amiss. The acceptance or rejection of a piece of steel should be determined just as a good lawyer determines the guilt or innocence of the accused person. One significant fact alone will not convict or acquit but many of them linked together make a circumstantial chain that is undeniable in force. Recently there occurred the failure of an important stressed part of railway equipment. The investigating metallurgist took a tensile specimen and also made some photomicrographs, using a comparatively high magnification (500 dia.) and a nital etch which was so heavy as to be practically useless. The broken tensile test piece showed to the naked eye at least three glaring faults—dirty steel, internal fissures and evidence of pipe—in addition to having pulled very low in elongation and reduction of area. However, these defects were passed by entirely and the report returned that the failure was due to abnormal grain size on the strength of the photomicrograph alone.

Practical Tests.

Frequently information is desired as to just what tests, simple and indicative of good steel, are feasible for the use of small consumers who do not possess the facilities for properly testing steel. In such a situation dependence can be placed to a great degree on a heavy etch, a light etch and hand-glass examina-



Physical testing laboratory. (Left)—Tensile testing laboratories. (Right)—Brinell and scleroscope machines for testing, electric furnaces for heat treating specimens.

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tion and the sulphur print. There is no easy method of analysis, except that carbon can be judged by fracture after quenching in water. As above pointed out, the consumer should not be too quick to condemn on the unsupported evidence of the etch tests and a bad appearance should only arouse suspicions to be confirmed by other and more exact tests. Sometimes a heavy etch will produce the most fantastic appearance in the best of steel and it is, of course, well known that it will show up forging lines, which might be condemned by the uninitiated.

Sulphur Prints.

The sulphur print test is worthy of a short description. The bar in question is machined or filed smooth on one end and polished with successively finer grades of emery cloth. Then a sheet of ordinary developing-out photographic paper is dipped for a few minutes in a 3 to 5 per cent solution of sulphuric acid and placed on the polished area so that it will be in contact throughout with the metal. After a minute or so the paper is stripped from the steel and will be found marked with numerous brown spots. If the pattern is close and uniform the steel is probably good; otherwise, it should be viewed with suspicion and other tests made.

There is still another etch test which for microscopic examination has rapidly increased in popularity since 1920 when it was discussed in a Bureau of Standards scientific paper. The specimen for this test must have a fairly good plish, such as obtained by 00 emery or as a result of surface grinding. It is swabbed for several minutes with an aqueous solution of ammonium persulphate and then washed in fresh water, after which the surface will exhibit a particularly good etch, though it is not heavy. It will be found that this process shows up details, such as crystalline structure, sponginess, segregation, flow lines and discontinuities, better than etching with other of the more common reagents.

Freak Tests.

It is probably unnecessary to say that the practical demonstrations of driving chisels through billets and cutting nails with hatchets are more in the nature of tricks than tests. In the same class are the tests made by the promoters for some new dope that "added, to the bath, will make any .30 carbon steel the equivalent of the best high carbon tool steel." It will be discovered upon trial that any good steel of the same analysis can perform the same stunts under the same conditions. During the war a compound of this sort gained considerable publicity, initiated by the backing which it received from a high official in one of the government departments. Strange to say during its brief but brilliant career several well-known technical agencies gave it very high recommendations and it was tried out for a number of purposes, including naval guns, although as far as the writer was able to determine its sole beneficence was due to an inconsiderable quantity of nickel which was disseminated through the steel. Lost to sight for a few years, it was again in the limelight a few months ago as the revolutionary agent by which one of the steel companies expected to stage a financial comeback.

It should be emphasized that dubious practices are not countenanced by any reputable steel makers. In fact, the steel manufacturer is so jealous of his reputation that it often happens his own specifications and inspection are harder to meet than the cutomer's and the customer is, therefore, sure of getting certainly as good steel as he orders—perhaps better.

Maintenance and Repair of Commutators

Sparking at Brushes or Improper Maintenance of the Commutator Is Largely Responsible for Inefficient Operation of Direct Current Motors and Generators

By **EARL B. STAVELY**[*]

MUCH of the trouble encountered in the operation of a direct current motor or generator is due to one of two causes—serious sparking at the brushes, or improper maintenance of the commutator. The maintenance and repair of commutators will be discussed in this article. The causes of sparking, their symptoms and remedies, were discussed by the writer in previous articles. (See Blast Furnace and Steel Plant, April, May, June and July, 1926.)

Cost of Maintenance.

The cost of proper maintenance of a commutator is quite low. The commutator is the "weak spot" of a direct current machine, hence it should be inspected daily. It pays to detect causes of commutator trouble before these troubles seriously affect the operation of the machine. A daily inspection requires but a few moments and, therefore, costs very little. Other maintenance work, which will be discussed later, requires comparatively little time, labor and material if the commutator is not allowed to get into very bad condition before it receives attention.

Lack of proper maintenance leads eventually to one thing—costly repairs. These repairs are rendered necessary by the failure of the commutator, by failure of the armature winding, or by extremely serious sparking at the brushes. The cost of repairs to a commutator or armature winding is usually quite high. In addition to this cost, a further loss is incurred due to the fact that the machine must be taken out o service while repairs are being made.

It should be evident that proper maintenance is a "paying proposition," since it costs so little and since, if properly carried out, it greatly reduces the amount of repair work necessary to keep the machine in service. In many cases, however, little attention is given to an electrical machine until trouble develops. Even then the machine is often kept in service if the trouble does not appear to be serious at the time, and no steps are taken to eliminate the causes of the trouble.

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Commutator Seasoning.

Many commutator troubles result from failure to consider certain facts relating to the seasoning of commutators. A commutator is said to have been "seasoned" when the insulation has been thoroughly baked out and all the parts have "set" in their final positions. A commutator becomes thoroughly seasoned only after it has been in service for some time. The manufacture of a direct current machine includes a number of processes intended to carry this seasoning as far as is economically possible before the machine leaves the factory. The purchaser should realize that suitable attention should be given to the commutator by him while the process of seasoning is naturally completed after the machine is placed in service.

Large commutators require more attention during the seasoning period than small commutaors. The maintenance work generally required in connection with this seasoning process includes little more than tightening of the bolts holding the V rings and the resurfacing of the commutator face.

After a new machine has been in operation for some time a careful examination of these bolts should be made. Loose bolts should be tightened, but this should be done cautiously. The bolts on most commutators are strong enough to distort the V ring. A distorted ring always causes commutator trouble, which frequently is of a serious character. It should be noted, too, that the bolts should be tightened while the commutator is hot, that is, immediately after the machine has been in operation under normal loading conditions.

The resurfacing of the commutator face will be discussed in following sections.

Commutator Surface.

A commutator should develop, after a reasonable period of service, a polished surface of a chocolate brown color. A commutator which shows a surface of this kind usually requires little attention other than an occasional wiping with a piece of dry nonlinting cloth, and an occasional cleaning of the slots between bars if the mica is undercut. Failure to develop a surface of this kind is an indicaton of the existence of some source of trouble.

Blackening of the commutator is generally caused by sparking at the brushes. This blackening may extend over the entire face, or may occur only at certain parts or at individual bars.

Blackening of a dull dirty appearance is generally caused by sparking resulting from the presence of dirt on the commutator. Blackening of a clean bright appearance indicates burning of the copper by sparking due to causes other than the presence of dirt. Proper maintenance under conditions such as these includes cleaning of the commutator and the elimination of sparking in so far as is possible.

A raw copper color of the commutator face is usually an indication of excessive grinding away of the bars by the brushes. This may result from excessive brush pressure or the use of brushes which are too abrasive.

Roughness of the commutator face, high mica, high or low bars, flat spots, and eccentricity are conditions which indicate that the commutator should receive attention. All of these conditions cause sparking at the brushes. The sparking will continually become worse if these conditions are not remedied by resurfacing the commutator. An attempt should be made, at the same time, to discover and eliminate the original cause of the commutator condition.

A commutator can be resurfaced by sanding, stoning, grinding, or turning. The method to be used in an individual case depends chiefly upon the condition of the commutator.

Sanding.

Sandpapering is generally satisfactory for cleaning commutators which are dirty or for resurfacing in case the commutator is slightly rough. Sanding will not remedy flat spots, high or low bars, high mica, or eccentricity. It will not properly surface a commutator which is quite rough.

Sandpapering a commutator is such a simple process that certain important precautions are often overlooked when this is done. Certain of these precautions will be noted briefly before proceeding further.

A quartz paper of fine grain should be used. If a course grained paper is used it is generally found impossible to avoid scratching the commutator surface, and especially to avoid forming the diagonal scratches which result when particles of the sand become detached from the paper. Diagonal scratches are objectionable since they greatly increase the rate at which the brushes are worn away and since they rapidly fill up with dirt and brush carbon. Many maintenance men draw the paper across a piece of metal several times before applying in order to remove large and loose particles of sand. This procedure is recommended, even though the paper used is of fine grain.

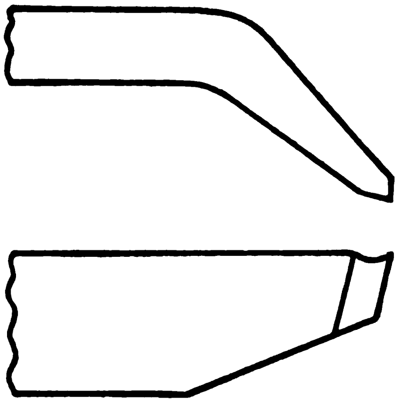


FIG. 1—Type of tool, and grinding of point, recommended for use in turning commutators.

Very little pressure should be applied to the paper. The paper should be moved slowly from side to side and should also be moved up and down. This later movement assists in preventing the development of flat spots.

The machine should be run at about normal speed during sanding of the commutator. It is difficult to obtain a well polished surface if the speed is low.

After the surface has been well sanded and is quite smooth careful attention should be given to the final polishing. The surface may be well polished by first using sandpaper to which a very small amount of oil has been applied, and by then finally using the back of the paper. The machine should then be carefully cleaned, special attention being given to the brushes and brush holders.

Emery cloth or paper should never be used on commutators. Particles of the emery become imbedded in the coper bars and the brushes and this greatly increases the grinding away of both the bars and the brushes. Emery is an electrical conductor and short circuits between bars may result if particles of emery become imbedded in the mica between the bars.

Sanding should be employed chiefly to keep the commutator free from dirt and slight blackening due to sparking. Sanding will not remove flat spots, remedy high or low bars, or greatly improve a commutator which is quite rough or grooved.

It should be noted also that sandpapering tends to flatten the center of bars of commutators having flush mica, and to flatten the edges of bars of commutators having undercut mica. These faults can be remedied in part by attaching the sandpaper to a block of wood which has been cut to fit the curvature of the commutator face.

Stoning.

Commutators which are too rough to be satisfactorily surfaced with sandpaper, or which show small flat spots, may be surfaced by stoning with a hand stone. In many cases commutators are resurfaced by turning, even though stoning would have given satisfactory results. This should be avoided since in turning considerable copper is cut away before the job is completed. Unless the commutator is in poor condition the removal of a few thousandths of an inch by stoning will usually give a satisfactory surface.

It is advisable to use only stones which are specially prepared for commutator grinding. These can be purchased in a variety of sizes and grades, hence no difficulty should be experienced in obtaining a stone of suitable size and quality. These stones are free cutting and have a smooth fine grain.

If the commutator has flat spots the stone should be shaped to fit the curvature of the commutator face. A stone thus shaped will eliminate flat spots while a flat stone will usually exaggerate these spots by broadening them.

Oil and grease should be carefully removed from the face of the commutator before stoning. The presence of oil or grease will cause the stone to glaze over with copper, after which it will fail to cut properly.

The armature should be run at about normal speed during stoning. The brushes should be raised, if possible, since the grit will rapidly wear away the brushes. The stone should be slowly worked from side to side in order that the entire commutator face will be ground down evenly.

The use of a stone as a hand turning tool is employed by some men to remove flat spots which cannot be removed by ordinary stoning. Considerable skill is required here in order to avoid scratching and pitting the commutator. For this reason it is suggested that grinding or turning be employed to surface commutators which are in such bad condition that they cannot be surfaced satisfactorily by ordinary stoning.

After stoning the commutator should be given a final finish with sandpaper as described in the preceding section. The entire machine should then be cleaned. Careful attention should be given to the slots between bars of commutators having undercut mica. These slots should be thoroughly cleaned and made free from dirt and copper dust.

It should be noted that stoning will not true up a commutator which is eccentric. Stoning will not give satisfactory results if the commutator is in such condition that vibration of the stone cannot be avoided. Grinding or turning should be carried out in such cases.

Grinding.

Commutators are sometimes ground by the use of a stone clamped in a suitable holder, the stone used being similar in quality to those used in hand stoning. This method is not generally recommended since considerable difficulty is usually experienced in determining the best cutting speed and since the commutator may be seriously damaged if the stone is not rigidly supported and happens to dig into the commutator. The use of a revolving wheel grinder is, therefore, recommended.

Commutator grinding machines, with revolving wheels, are available in a variety of types. The different types vary chiefly in minor design features and details of application. The abrasive wheels used with these grinders should preferably be of medium soft grade. Hard wheels tend to fill up rapidly with copper, after which they do not give satisfactory performance.

Before grinding is started suitable provision should be made to prevent dust or copper chips from working into the armature winding. This can be done by using a strip of closely woven cloth which is long enough to encircle the commutator and several inches wider than the end connections of the armature winding. The cloth should first be wrapped around the commutator ;the inside edge should then be firmly tied, with strong cord, as closely as possible to the end connections; the cloth should then be turned up over the end connections of the coils and carefully bound with cord to the outside of the armature. The field coils should also be covered in similar fashion.

The machine should be operated at about normal speed. The best speed of the grinding wheel must be determined by trial. A speed of about 1700 rpm. is usually satisfactory with the average grade of wheel.

The best job of grinding is obtained by taking many light cuts instead of a few heavy cuts. Vibration of the grinding machine and wheel, and spring of the supporting fixtures, cannot be entirely avoided if heavy cuts are made. For these reasons heavy cuts usually make flat spots and eccentricity worse instead of better.

After the commutator has been made as true as it is possible to grind it, the face should be carefully polished with sandpaper as described in a preceding section. The entire machine should then be thoroughly cleaned. Particular attention should be given to the slots between bars of commutators having undercut mica. All dirt and copper dust must be removed from these slots if possibility of short circuits between bars is to be avoided. Examination of these slots with a hand glass or small magnifying glass is recommended.

It is advisable, before grinding a commutator, to tighten the bolts holding the V rings if such tightening appears necessary. This should be done while the commutator is hot, and should be done cautiously for reasons which were noted previously.

Turning.

Commutators may be turned either with the armature in place or in a lathe. The former method is used only in the case of large machines. The armatures of small machines should be turned in a lathe.

Before turning a commutator provision should be made, as was explained under "Grinding," to exclude dust and copper chips from the armature winding.

A reduced speed is necessary in turning since burning will result if the commutator is run at high speed. Burning usually results with surface speeds greater than about 300 feet per minute. If the commutator is turned with the armature in its own bearings an auxiliary driving motor should be used, if possible, to drive the armature at the desired speed. If a motor is not available for this purpose special provision must be made for operation of the machine at reduced speed—either by the use of auxiliary resistance in the armature circuit, or by the use of reduced voltage.

A side cutting tool, with the point slightly rounded, is generally considered best for commutator turning. The tool should be sharp enough to make a clean, smooth cut—this is important since a dull tool will drag copper from bar to bar over the mica. The cutting side and point should be given considerably more rake, in grinding the tool, than is customary in preparing tools used in working iron and steel. The type of tool recommended for this purpose is shown in Fig. 1.

The tool should be securely fastened and its support should be rigid. Light, rather than heavy, cuts should be made with a fine feed. If the cut is heavy the tool tends to twist the bars. If the feed is not fine a "thread" may be cut in the commutator face which can be removed only by additional and unnecessary work. Considerable care should be taken during the first few cuts . An eccentric commutator, or one having bad flat spots or grooves, may be seriously damaged if light cuts are not taken until the commutator has been made fairly true.

After the turning is completed the tool marks should be carefully removed with a file. It is recommended that the file be chalked before this is done. The ends of the bars should be rounded, with a file, to a radius of about a sixteenth of an inch. Short circuits may develop between bars if the ends are not thus rounded since the mica breaks out easily at this part of the commutator if the bars are left square.

Oil and Grease.

A commutator should be kept free from oil and grease. This is an item which is often given insufficient attention in the maintenance of direct current machinery.

Oil, especially when hot, will penetrate the mica between the bars and dissolve the varnish used as a binder in forming the thin flakes of mica into plates. This at once makes it easier for a greater amount of oil to penetrate the mica, hence the action is cumulative. The oil carries with it carbon and copper dust, dirt, etc., and the presence of this foreign material in the mica eventually leads to the development of short circuits between bars.

This source of trouble often makes itself first evident by the formation of pitted spots in the mica, these spots being produced by the burning caused by leakage currents from bar to bar These leakage currents, during the early stages of this trouble, are not sufficiently high to cause overheating of the armature winding, but are sufficient to cause pitting of the mica.

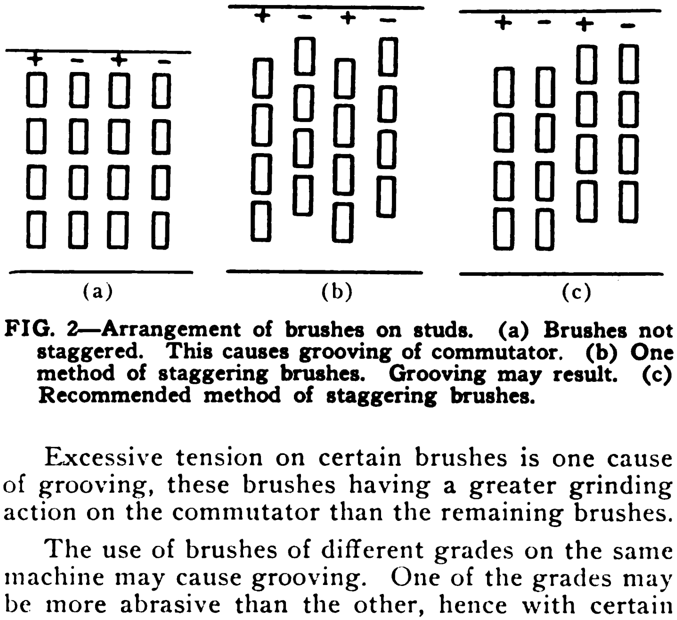
If this trouble is detected soon after this pitting action has started the commutator may usually be overhauled by turning it down until the pitted spots have been eliminated. Frequently, however, the trouble is not detected until, due to deep penetration of oil, the pitted spots become too deep for elimination by turning. In such cases the defective mica must be replaced.

Special care should be taken to keep oil and grease away from commutators having undercut mica. These commutators are subject to the trouble just discussed and also to another trouble—that of short circuits between bars resulting from an excessive amount of dirt in the slots between bars. If the undercutting is properly carried out, as will be discussed later, these slots should "clean themselves," that is, the rotation of the commutator will throw out particles of dust and dirt which tend to lodge in the slots. The presence of oil or grease not only interferes with this self cleaning action, but also hastens the accumulation of dust and dirt in the slots.

Under most conditions of operation it is not possible to prevent the gradual accumulation of dirt in the slots of undercut commutators. For this reason the maintenance of such commutators should include a careful inspection of these slots. If they are found to be dirty they should be carefully cleaned. This cleaning should not be neglected since, while dirt may collect slowly at first, the filling up of the slots proceeds rapidly after the slots have become slightly dirty.

Grooving of Commutator.

Any tendency toward the formation of grooves in the face of a commutator should be investigated as soon as this action is detected. Grooving may result from a variety of causes, all of which can generally be eliminated without difficulty.



(a) (b) (c)

FIG. 2—Arrangement of brushes on studs. (a) Brushes not staggered. This causes grooving of commutator. (b) One method of staggering brushes. Grooving may result. (c) Recommended method of staggering brushes.

Excessive tension on certain brushes is one cause of grooving, these brushes having a greater grinding action on the commutator than the remaining brushes.

The use of brushes of different grades on the same machine may cause grooving. One of the grades may be more abrasive than the other, hence with certain arrangements of the two grades on the studs certain parts of the commutator may be worn down more rapidly than the other parts and grooves are formed in the face.

Grooving of the commutator may result if brushes are not properly "staggered" on the studs. The first arrangement of brushes shown in the illustration, Fig. 2, where the brushes are not staggered, leads to grooving. The action here is so evident that it needs no discussion.

The second arrangement shown in the figure is one method of brush staggering which is sometimes employed. This insures uniform wearing down of the commutator by the brushes if the tension is properly adjusted on all brushes. The formation of grooves may result in this case, however, due to another cause which is sometimes overlooked, hence it will be described in some detail here.

Current flowing across any contact tends to carry with it very small particles of the material from which the current leaves and to deposit these particles on the material forming the other part of the contact. For this reason carbon is carried away from the brush and deposited on the commutator where the current passes from brush to commutator. In like manner copper is carried from the commutator and deposited on the brush where the current passes from commutator to brush. In Fig. 2-b, where the plus signs indicate brushes at which the current flows from commutator to brush, the commutator copper will be slowly burned away by this action under the plus brushes while no copper will be burned away by this action under the minus brushes.

This action varies in magnitude in different machines and under different conditions of operation. In many cases the grooving due to this cause is extremely slight; in other cases it is quite objectionable.

It is well to eliminate possibility of grooving due to this cause by staggering the brushes in pairs as indicated in Fig. 2-c. This at once insures even wearing down of the commutator by this burning action of the current, and also insures an even wearing down of the commutator by the grinding action of the brushes.

(To be concluded next month.)

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By VICTOR S. POLANSKY[*]

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Brief note concerning a novel plan for making small quantities of high-manganese and low-carbon steel castings.

Nichols, Wesley G. Art of Making Manganese Steel. (United States patent, 1,359,268.)

Relates to production of manganese steel from manganese steel scrap.

Nichols, Wesley G. Electric-Furnace Melting of Manganese Scrap. (United States patent, 1,460,106.)

Process of melting manganese steel scrap for reuse.

Nichols, Wesley G. Heat Treatment of Manganese Steel. (United States patent, 1,427,121.)

Improvement in heat treating manganese steel castings, which consists in subjecting such castings to a temperature which never exceeds the critical temperature of the castings.

Nichols, Wesley G. Heat Treatment of Manganese Steel. (United States patent, 1,517,451.)

Nichols, Wesley G. Method of Making Manganese Steel. (British patent, 12,762 of 1914.)

Relates to manufacture of manganese steel by utilization of manganese steel scrap.

Nichols, Wesley G. Method of Making Manganese Steel. (United States patent, 1,291,655.)

Special reference to manufacture by the Bessemer process.

Nichols, Wesley G. Method of Making Steel. (United States patent, 1,100,905.)

Improved method of making steel, particularly manganese steel, the object being to provide an effective method of production by utilizing manganese steel scrap without material loss of its carbon and manganese content.

Nichols, Wesley G. Method of Melting Manganese Steel. (United States patent, 1,494,011.)

Relates to melting of manganese steel scrap for casting into manganese steel objects, and reducing the loss of manganese in the process of melting the steel scrap.

Nichols, Wesley G. Method of Recovering Manganese Steel. (United States patent, 1,291,656.)

See also United States patent, reissue, 15,435.

Nichols, Wesley G. Method of Recovering Manganese Steel. (United States patent, reissue, 15,435.)

Relates to method of recovering scrap which contains manganese in sufficient proportions to render the steel of especial value.

See also United States patent, 1,291,656.

Nichols, Wesley G. Process of Making Manganese Steel. (United States patent, 1,356,551.)

Improvement in the manufacture of manganese steel from manganese steel scrap.

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The same, abstract. 1926. (In Iron and Coal Trades Review, v. 112, p. 858.)

Treats of the advantages of manganese steel over Bessemer and open-hearth steels for steel shear knives.

Norris, George L. Alloy Steels. 1915. (In Transactions of the International Engineering Congress, v. 10, p. 26-36.)

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The same, condensed. 1915. (In Metallurgical and Chemical Engineering, v. 13, p. 739-742.)

Deals very briefly with the application and chemical properties of manganese steel.

Oberg, Erik, and Jones, Franklin D. Iron and Steel. 1918. Industrial Press.

Discusses manganese steel, p. 265-267.

Opens Western Manganese Steel Plant. 1925. (In Foundry, v. 53, p. 491.)

Brief description of the equipment of the American Manganese Steel Company plant at Los Angeles.

Osborne, Charles G. Process of Treating Manganese-Steel Ingots. (United States patent, 1,094,090.)

Refers particularly to the heat treatment of ingots, and the products therefrom.

O'Shea, L. T. Effect of Oxidation on the Magnetic Properties of Manganese Steel. 1890. (In Report of the British Association for the Advancement of Science, v. 60, p. 753.)

The same. 1890. (In Journal of the Iron and Steel Institute, v. 37, p. 837.)

Brief abstract of a paper read before the association, stating that drillings of manganese steel containing 25 per cent or less of manganese are magnetic due to oxidation which causes formation of magnetic oxid of iron.

Osmond, F. On the Critical Points of Iron and Steel. 1890. (In Journal of the Iron and Steel Institute, v. 36, p. 38-71.)

Discussion, p. 72-80.

Considers manganese steel, p. 57-59, and includes a brief bibliography.

Piwowarsky, E. Phosphid im Manganstahl. 1925. (In Stahl und Eisen, v. 45, pt. 2, p. 1075-1076.)

The same, abstract translation. 1926. (In Iron Age, v. 117, p. 482-483.)

The same, abstract translation. 1925. (In Metallurgist, v. 1, p. 126.)

States that the presence of "free phosphide" and "free carbide" was noted through a special etching on manganese steel castings with high phosphorus content; and by annealing for several hours and subsequent hardening, "phosphide" went into solution.

Poldihütte Tiegelgusszstahlfabrik. Improvements in and Relating to the Heat Treatment of Manganese Steel. (British patent, 12,011 of 1914.)

Relates to an improved process for treating high-manganese steel, in order to render the steel capable of being machined.

Potter, Winfield S. Heat Treatment and Rolling of Manganese Steel. (United States patent, 1,018,000.)

Consists in first heating the ingots above the melting point of the eutectic, rolling to a bloom, cooling, and working to a finished shape at temperatures below 1075° C.

Potter, Winfield S. Heat Treatment of Large Manganese-Steel Shapes. (United States patent, 1,018,368.)

Method of producing thick shapes devoid of strains, working the metal into the required form and cooling to a temperature below 420° C. at such rate as to avoid separations within the mass.

Potter, Winfield S. Heat Treatment of Manganese Steel. (United States patent, 1,017,907.)

Potter, Winfield S. Heat Treatment of Manganese Steel. (United States patent, 1,123,003.)

Relates to a method of heat treating rolled, forged, and otherwise wrought shapes of manganese steel.

Potter, Winfield S. Improvements in Methods of Producing Wrought Shapes of Manganese Steel. (British patent, 2324 of 1912.)

Relates particularly to the conditions under which the steel should be cast, heat treated, worked, and quenched.

See also British patent, 1479 of 1912.

Potter, Winfield S. Improvements in Working Manganese Steel to Produce Finished Shapes. (British patent, 24,685 of 1908.)

Object is to produce finished shapes from manganese steel by rapid reductions.

Potter, Winfield S. Improvements in Working Manganese Steel to Produce Finished Shapes. (British patent, 24,729 of 1909.)

Potter, Winfield S. Improvements Relating to the Manufacture of Manganese Steel. (British patent, 1479 of 1912.)

Purpose of invention is to increase the hardness, elastic limit, and resistance to failure of the steel.

See also British patent, 2324 of 1912.

Potter, Winfield S. Making Manganese-Steel Car-Wheels. (United States patent, 1,018,364.)

Potter, Winfield S. Manufacture of Chains. (United States patent, 1,018,363.)

Cutting manganese steel bar into pieces suitable for links, bending, interlocking the pieces, and electrically welding their ends.

Potter, Winfield S. Manufacture of Manganese Steel. (United States patent, 968,601.)

Relates to preparation of manganese steel adapted to working.

Potter, Winfield S. Manufacture of Manganese Steel. (United States patent, 968,602.)

Involves the prevention of large and coarse crystals by lowering the temperature of the outer portions of the ingot.

See also United States patent, 562,374.

Potter, Winfield S. Manufacture of Manganese-Steel Wire. (United States patent, 1,018,369.)

Potter, Winfield S. Manufacture of Perforated Plates of Manganese Steel. (United States patent, 1,018,370.)

Method of perforating plates which have first been brought into an austenitic condition.

Potter, Winfield S. Manufacture of Pins, Links, and the Like from Manganese Steel. (United States patent, 1,018,361.)

Consists in heating manganese steel, rolling the heated blank, cutting the bar into lengths, mechanically working, and finally cooling rapidly.

Potter, Winfield S. Manufacture of Sheets and Plates of Manganese Steel. (United States patent, 1,017,903.)

Relates to the rolling of sheets or plates from manganese steel billets or blanks, having above 5½ per cent, and usually 12 per cent. of manganese.

Potter, Winfield S. Manufacture of Sheets and Plates of Manganese Steel. (United States patent, 1,018,002.)

Consists of heating a billet of manganese steel, rolling and working at temperatures which, in the finishing stages, are below 800° C., reheating and quenching.

Potter, Winfield S. Manufacture of Sheets or Plates of Manganese Steel. (United States patent, 1,017,908.)

Potter, Winfield S. Method of Machining Manganese Steel. (United States patent, 1,018,001.)

Method of machining blanks of manganese steel previously heat treated to a temperature between 300° and 1075° C., and finally toughening by water quenching.

Potter, Winfield S. Method of Forming Machined Shapes of Manganese-Steel. (United States patent, 1,079,439.)

Object is to facilitate and cheapen machining of manganese steel parts.

Potter, Winfield S. Method of Producing Finished Shapes of Manganese Steel. (United States patent, 938,891.)

Relates to a method whereby an ingot may be made sufficiently coherent to elongate without crushing in the rolling or shaping thereof.

Potter, Winfield S. Method of Producing Finished Shapes from Manganese Steel. (United States patent, 939,164.)

Relates especially to the rolling of manganese steel ingots into rails.

Potter, Winfield S. Method of Producing Wrought Shapes of Manganese Steel. (United States patent, 1,017,906.)

Relates particuarly to conditions under which steel should be cast, heat treated, worked, and quenched to give a dense, fine-grained, and uniform crystalline structure.

Potter, Winfield S. Method of Treating Manganese Steel. (United States patent, 974,822.)

Relates to treatment of manganese steel previously strengthened and toughened by rapidly cooling, so that it may be worked.

Potter, Winfield S. Producing Rolled Shapes of Manganese Steel. (United States patent, 1,017,904.)

Object is to produce a rolled manganese steel rail or bar with a continuous fine-grained austenitic structure.

Potter, Winfield S. Process of Preparing Manganese-Steel Ingots for Rolling. (United States patent, 975,370.)

Casting and heat treating of manganese steel and more particularly obtaining the ingots in such a physical condition that the metal will withstand rolling when heated to a high temperature.

Potter, Winfield S. Process of Rolling Manganese Steel. (United States patent, 938,893.)

Object is to produce finished shapes without impairing the quality of the material.

Potter, Winfield S. Process of Treating Manganese-Steel Ingots. (United States patent, 938,892.)

Production of manganese steel ingots having a large cross-sectional area.

Potter, Winfield S. Producing Wrought Shapes of Manganese Steel. (United States patent, 1,278,207.)

Refers to steel containing over 5½ per cent of manganese, with or without silicon or alloying metals, and any suitable proportion of carbon.

Potter, Winfield S. Production of Machined Shapes of Manganese Steel. (United States patent, 1,018,366.)

Heat treating and working the manganese steel blanks, and avoiding loss of toughened state during final machining.

Potter, Winfield S. Production of Manganese-Steel Forgings. (United States patent, 1,018,362.)

Consists in forming from manganese steel in a plastic condition, and completing the forming operation below 1075° C.

Potter, Winfield S. Production of Sheets and Plates of Manganese Steel. (United States patent, 1,017,905.)

Potter, Winfield S. Production of Wrought Shapes of Manganese Steel. (United States patent, 1,018,367.)

Consists in regulating the rate and extent of cooling of the cast shapes, and equalizing the temperature throughout.

Potter, Winfield S. Production, Treating, and Rolling of Ingots of Manganese Steel. (United States patent, 975,371.)

Relates to production of manganese steel usually containing from 10 to 15 per cent of manganese, and from 0.80 to 1.25 per cent or more of carbon.

Potter, Winfield S. Treating Manganese Steel. (United States patent, 939,163.)

Relates to treatment of ingots for the purpose of forming strong, tough surface preparatory to rolling.

Potter, Winfield S. See also Manganese Steel Rail Company.

Primitive Manganese Steel Manufacture in India. 1888. (In Engineering and Mining Journal, v. 46, p. 395.)

Original in "Geological Survey Records of India," v. 21, pt. 3 .

Quinn, J. M. Making Cast Manganese Steel. 1924. (In Foundry, v. 52, p. 964-966.)

Outlines electric-furnace practice for the manufacture of manganese steel, and gives brief information concerning methods of heat treatment.

Recent Development in Rail Steel. 1926. (In Iron Age, v. 117, p. 336-338.)

1. A special manganese rail and its advantages.
2. Transverse fissures—discovery, cause and remedy.

Discussion of a special manganese steel rail used by leading American railroads, said to minimize transverse fissures.

Report on Design of and Specifications for Manganese Frogs and Crossings. 1917. (In Proceedings of the American Railway Engineering Association, v. 18, p. 406-413.)

Tentative plans and specifications of Committee on Track.

Rolled Manganese Steel Rails. 1909. (In Iron Age, v. 83, pt. 2, p. 1261-1262.)

Gives brief description and results of tests of a manganese steel known as "Manard steel," a product developed by the Pennsylvania Steel Company.

Round Table Discussion on Alloy Steels. 1926. (In Transactions of the American Society for Steel Treating, v. 9, p. 154-159.)

Discussion by the New York chapter of the Society. Manganese steel was taken up by J. H. Hall, p. 157-158.

Roux. Rechargement de rails en acier au manganèse. 1923. (In Revue de métallurgie, mémoires, v. 20, pt. 1, p. 490-492.)

Railway crossings, etc. are covered with manganese steel by arc welding with a manganese steel electrode. Adherence is improved by drilling holes at an angle into the material to be coated.

Schäfer, Rudolf. Die Konstruktionsstähle und ihre Wärmebehandlung. 1923. Springer.

Discussion of manganese steel, with a number of foot-note references. p. 277-291.

Scheffer, Friedrich. Improved Method of and Apparatus for the Heat Treatment of Manganese Steel Articles. (British patent, 112,986.)

Schaffer, Friedrich. Method of and Apparatus for Hardening Manganese-Steel Articles. (United States patent, 1,362,147.)

Relates to heat treatment of manganese steel articles, particularly those having intricate shapes.

Schaffer, Friedrich. Method of Making Railway Disk Wheels. (United States patent, 1,391,907.)

Relates to the use of manganese steel.

Schudel, B. Manganese Steel and Its Production in a Héroult Furnace for Steel Castings. 1920. (In Chemical Abstracts, v. 14, pt. 1, p. 1263-1264.)

Original in "Schweizerische Bauzeitung," v. 74, p. 129-131.

Deals with effect of various percentages of manganese on the properties of manganese steels, and considers the advantages of melting in the electric furnace.

Servais, J. Some Considerations on the Position of the Question of Steel Rails in Belgium. 1925. (In Bulletin of the International Railway Congress Association, v. 7, p. 2184-2217.)

Manganese steel, p. 2209-2217.

Smith, B. K. Welding Manganese Steel by the Oxy-Acetylene Process. 1924. (In Engineering and Contracting, v. 62, p. 882-884.)

Describes method of repair of worn or broken rail parts.

Société Anonyme des Hauts Fourneaux Forges et Aciéries de Pompey. Process in the Manufacture of Manganese Steel. (British patent, 201,539.)

A new process for the manufacture of hard steels containing a large proportion of manganese.

Sonntag, C. H. Manganese Steel in the Clay Industry. 1926. (In Clay Worker, v. 86, p. 59.)

Abstract of article in "Pit and Quarry." Deals briefly with use of manganese steel in clay-working machinery.

Specifications for Switches, Frogs, Crossings and Guard Rails. 1921. (In Proceedings of the American Railway Engineering Association, v. 22, p. 654-673.)

Manganese steel frogs, p. 660-673.

Steward, H. M. Life of Manganese Steel Rail on Curves; Its First Cost and Cost of Maintenance Compared with Commercial Bessemer Rail, from Service Tests Made on the Elevated Division of the Boston Elevated Railway Company. 1908. (In Proceedings of the American Street and Interurban Railway Engineering Association, v. 6, p. 333-337.)

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The same, condensed. 1908. (In Engineering News, v. 60, p. 458.)

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The same, abstract. 1908. (In Engineer, v. 106, p. 544.)

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Author states that results obtained from manganese steel rails have been very satisfactory and recommends their use by railways operating under similar conditions.

Swain, George Fillmore. Structural Engineering; Fundamental Properties of Materials. 2 v. 1924. McGraw.

Considers constitution and properties of manganese steel, v. 2, p. 109-112.

Terény, Janos. Manganhaltiger Maschinenstahl als Ersatz der Specialstaehle. 1918. (In Stahl und Eisen, v. 38, pt. 1, p. 567-570.)

Original in "Bányászaty és kohászaty lapok," Feb. 1, 1918, p. 37-51.

Thallner, Otto. Tool-Steel; a Concise Handbook on Tool-Steel in General, Its Operations of Forging, Annealing, Hardening, Tempering, etc., and the Appliances Therefor. Tr. from the German by W. T. Brannt. 1902. Baird.

Brief consideration of manganese steel, p. 6.

Unmagnetisirbarer Stahl für Uhren u. dgl. 1887. (In Dingler's polytechnisches Journal, v. 263, p. 60.)

(Continued on page 410)

Selection of Coals for Coke Manufacture*

A Discussion of Physical and Chemical Characteristics of Coal for the Manufacture of Blast Furnace, Foundry, and Water-Gas Coke in By-Product Ovens

By H. J. ROSE†

PART II

GAS coals may be defined as high-volatile coking coals suitable for the manufacture of city gas. The term was formerly restricted to those coals that had proved satisfactory for use in coal-gas retorts, but this distinction is losing its importance, because of the very extensive use of coke-oven gas for city supply.

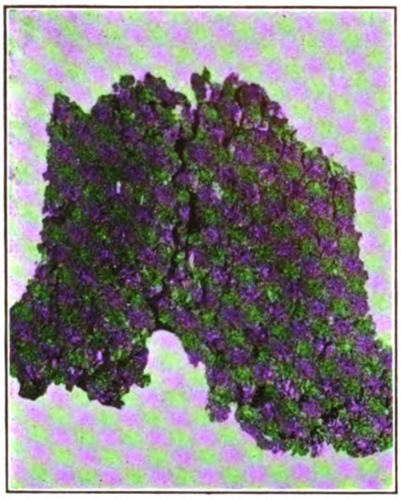

FIG. 11—Inferior pebbly coke formed from weathered Illinois slack coal, coked at normal rate (in narrow box).

More than half of the total coal gas distributed through city mains in the United States is now obtained from by-product coke ovens, and the proportion is rapidly increasing, as the following figures will indicate. In 1924, more than 65,000,000,000 cu. ft. of coke-oven gas were distributed through city mains. During the fiscal year 1924, new coal-gas capacity, due to Becker type ovens completed or contracted for and including coal gas released by building gas producers at older plants, amounted to 25,000,000,000 cu. ft. This enormous increase in annual capacity includes only those installations which will actually supply gas for city use.

Gas coals are characterized by a high yield of Btu.'s in gas per pound of coal, and they have a volatile content ranging from about 33 to 38 per cent, dry basis. When carbonized in by-product ovens, they may be used alone, or with an admixture of low-volatile coal to improve coke quality. The most widely known gas coals are produced in West Virginia, Kentucky, Pennsylvania and Virginia.

Gas coals should be low in sulphur, about one-quarter or one-third of which appears in the gas as hydrogen sulphide, which must be completely removed before the gas is sold for city use. Organic sulphur compounds such as carbon bisulphide also occur in the gas, and are not removed by any purification process commercially used in this country. This limits the permissible sulphur content of gas coals, since city regulations commonly specify that the total sulphur content of the gas shall not exceed 30 grains per 100 cu. ft. A 30-grain total sulphur specification is sufficiently liberal in most localities, and seldom interferes with the use of a coal which is considered satisfactory from the standpoint of hydrogen sulphide in gas, and sulphur in coke.

Most large gas companies require that gas coals for their use shall contain less than 1.25 per cent sulphur, and a large amount of gas coal used in this country has a sulphur content well under 1.00 per cent.

High-oxygen Coking Coal—Last to claim our attention are the high-oxygen coking coals, which contain about 8 to 11 per cent oxygen in the pure coal substance, and about 32 to 42 per cent volatile matter, dry basis. When such coals are carbonized, they tend to give a smaller, weaker and more fingery coke than any of the coals previously considered. Many of them give under some conditions, a more or less pebbly, friable product which cannot be termed good coke, and which has little commercial value. Gas is produced in good volume, but is only fair in quality, because of its large content of carbon dioxide and carbon monoxide and a reduced methane percentage. Coals of this type usually contain considerably more moisture than coals of higher rank and, furthermore, they yield a higher percentage of water of decomposition when coked.

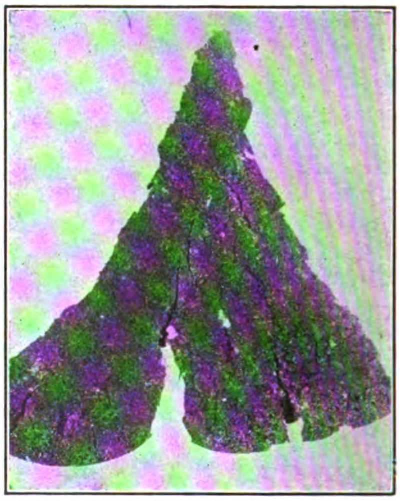

FIG. 12—Hard true coke formed from weathered Illinois slack coal. Coked at fast rate (in corner of same box as coke shown in Fig. 11).

High-oxygen coals require a distinctly greater amount of heat for carbonization than other coals, and a high coking temperature is required for best results. For these reasons both a higher coking temperature and slightly longer coking time are usually employed for carbonizing such coals.

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*A paper presented at the July, 1926, meeting of the American Institute of Mining and Metallurgical Engineers.

†Assistant Chief Chemist, The Koppers Company, Pittsburgh, Pa.

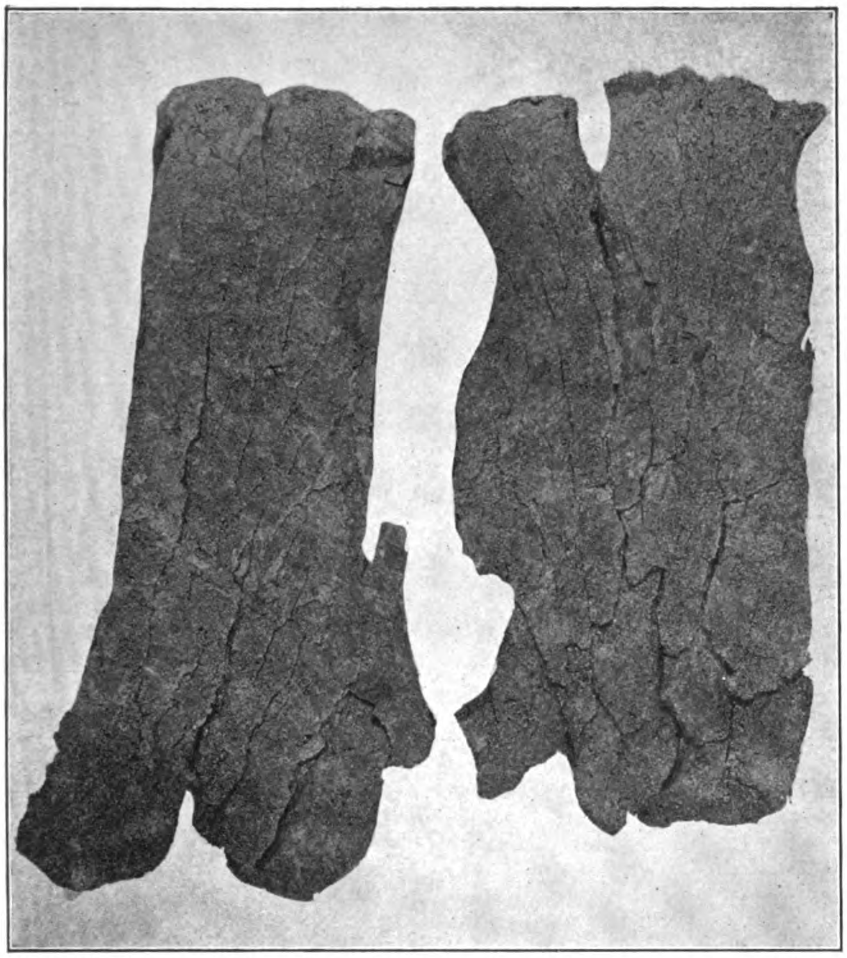

FIG. 13—Longitudinal section of regular plant coke produced from 40 per cent volatile-matter (high-oxygen) coal, Carbon County, Utah, in 14-in. Becker type ovens.

The beneficial effect of high temperature and rapid heat penetration is well shown by Figs. 11 and 12, representing longitudinal sections of two very different grades of coke made from the same coal in different parts of the same coking-test box. For this test weathered Illinois slack coal, classed as non-coking, was placed in a narrow sheet-steel test box and coked in an otherwise empty oven. Under these conditions, the test box was at once subjected to heat from all directions, and coking proceeded very rapidly at the angles and corners of the box, where heat passing through two or three faces was concentrated upon a limited amount of coal. Heat passing through the sides of the box carbonized most of the coal in the normal manner, and Fig. 11 shows the weak, pebbly and very inferior coke formed in this way. In the angles of the boxes, however, and particularly in the corners, a true, hard, bright coke was formed, as is shown by Fig. 12. This sample will serve to illustrate a pitfall into which inexperienced experimenters often fall, when they carbonize small quantities of specially treated coal in very hot laboratory furnaces, and "discover" that hard coke can be made from poorly coking coals by their process.

At Provo, Utah, a battery of by-product coke ovens is producing blast-furnace coke from 100 per cent Carbon County, Utah, coal.* This coal contains more than 10 per cent oxygen in the pure coal substance, and over 40 per cent volatile matter, dry basis. It is undoubtedly the lowest rank coal being carbonized in America, yet a very satisfactory furnace coke is being obtained. The coke is used to produce basic and foundry iron in a blast furnace 83 ft. high with a hearth diameter of 15 ft. P. W. Jackson, blast-furnace superintendent at this plant, stated in a recent article:* "The March production of 11,582 tons of iron with a low fuel consumption per ton of iron, compares favorably with any practice in the country and the limit of progress has not yet been reached." Fig. 13 illustrates longitudinal sections of the regular plant coke produced at Provo.

Many high-oxygen coals have been very successfully coked in the same type of oven. Fig. 14 shows run-of-oven coke from Illinois coal, lying on the coke wharf.

The coking properties of all coals are adversely affected by weathering (oxidation), and it is particularly essential that high-oxygen coals be carbonized in a freshly-mined condition in order to obtain best results.

The best known high-oxygen coking coals are those in Indiana, Illinois and Utah, but some are also found in Ohio, western Kentucky, Colorado, Washington, and other states.

Volatile Matter and Calorific Value for Coal Classification—It will have been noted in the preceding paragraphs that volatile matter alone is not a safe criterion for classifying coking coals, as the volatile-matter limits of high-oxygen coking coal, gas coal and high-volatile coking coal overlap considerably. This may be explained by the fact that although hydrogen and oxygen are both responsible for the formation of volatile matter, they act very differently in affecting the quality of coke and by-products obtained. Thus a gas coal of 34 per cent volatile matter may have excellent coking properties and give a high yield of rich gas, whereas a high-oxygen coal also having 34 per cent volatile matter may give a very poor coke under many conditions, and yield a gas of rather low heating value.

When coking coals are classified by means of their percentages of volatile matter, it is highly desirable to determine either their oxygen content or their calorific value. In fact, it is necessary to do so for the higher-volatile coals from unfamiliar mining districts.

It has long been known that the calorific value of a coal closely depends upon its ultimate analysis. Although we are primarily interested in the oxygen content of a coking coal, the calorific value is often more accurately determined than the oxygen figure, and moreover, it is frequently available when the latter figure has not been obtained. Parr† has proposed a classification of coals based upon the volatile matter and calorific value of pure or "unit coal." Fig. 15 represents the same 150 coking coals that are shown

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*C. T. Keighley, "The New By-product Coke Plant of the Columbia Steel Corporation. Min. and Met., 6 (1925), 422-24.

*P. W. Jackson, "Blast-furnace Plant of the Columbia Steel Corporation." Min. and Met., 6 (1925), 420-22.

†S. W. Parr, "The Classification of Coal." Jnl. Ind. and Eng. Chem. 14 (1922), 919.

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in Fig. 8. It will be noted that the curves are very similar, and that coals fall into the same classification when plotted by the two methods. The vertical scale in Fig. 15 is more compressed than that in Fig. 8, thus causing the points to fall within narrower limits along that dimension. The graph clearly shows how high-volatile coking coals, gas coals and high-oxygen coking coals overlap in volatile-matter content.

In addition to the use of Parr's special "unit coal" correction for ash and sulphur, the analyses in Fig. 15 have been calculated free of nitrogen, and calorific values, therefore, average some 200 Btu. higher than they otherwise would.

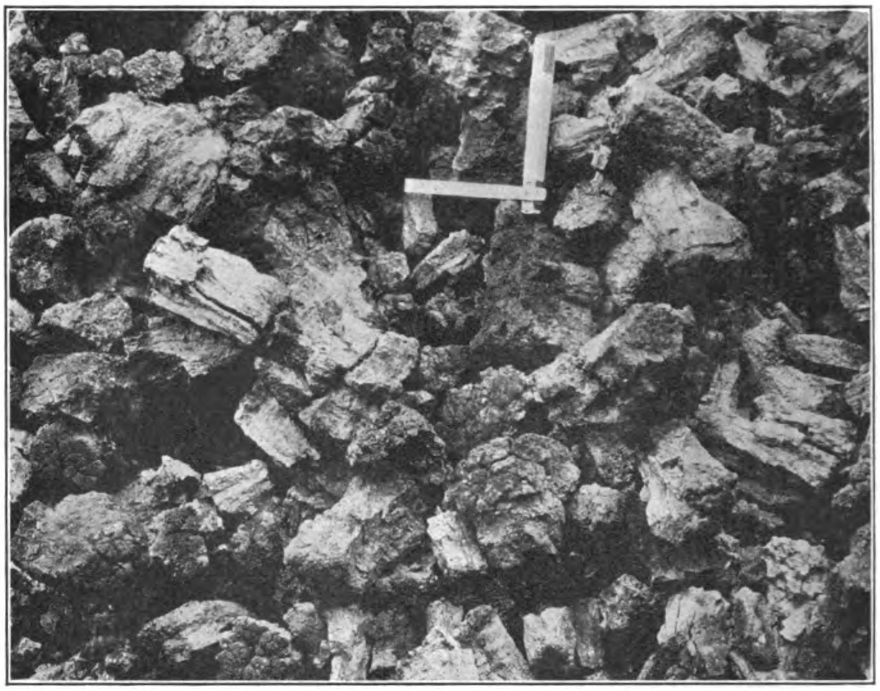

FIG. 14—Run-of-oven coke from 35 per cent volatile-matter high-oxygen coal, No. 6 seam, Jefferson County, Ill., on wharf. Coked in 14-in. Becker type ovens.

Coal Classes and Coke Structure.

The following generalization will prove useful, although they are subject to many exceptions due to the effect of independent variables.

Small-celled Coke—Low-volatile coals when coked alone, give large, tough blocky coke pieces which are vastly different in general appearance from the usually slender or fingery, more or less curved, and somewhat soft and brittle coke commonly obtained from the coking coals highest in oxygen. Yet the cell structures of these cokes have certain common resemblances. Both are characterized by small cells with thin cell walls (Figs. 16 to 19). The small size of the cells gives to these cokes a fine-grained appearance which sometimes leads to their being called dense. However, coke from low-volatile coal is of medium apparent specific gravity, whereas the coke from high-oxygen coking coals will be found to have a very low apparent specific gravity, in fact it is the lightest in weight of all cokes.

The cell structure of the low-volatile coke is often extremely uniform, whereas the high-oxygen coals frequently produce a coke containing large cells irregularly distributed and areas of cells with thicker walls. Both types of coal commonly contain more or less semi-coking or non-coking material (other than slate). The above cokes have a cell size approximating that of Ramsburg and Sperr's Standard No. 1.* The method used by The Koppers Company laboratories for sectioning coke has been described by Malleis.†

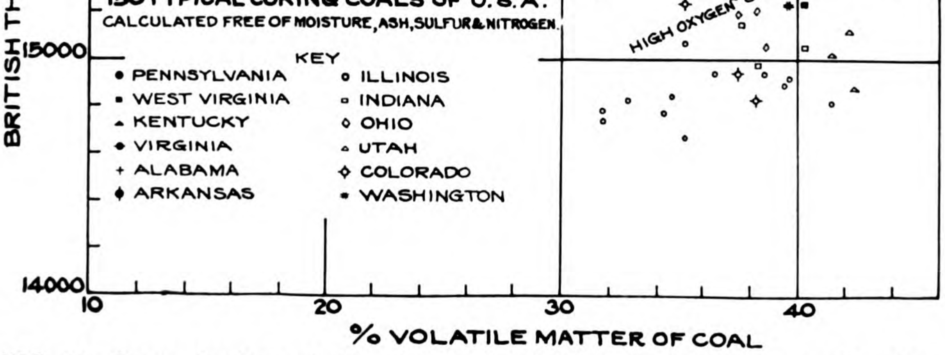

FIG. 15—Curve showing volatile matter and calorific value of the same 150 coking coals of the United States, ultimate analyses of which are plotted in Fig. 8.

Certain high-volatile coking coals tend to produce a small-celled (No. ½ to 2)‡ coke with very thick walls which is the hardest and densest of all types of coke (Figs. 20 and 21). Because of the large amount of shrinkage involved in the formation of a dense product from high-volatile coal, such coke is characterized by many longitudinal shrinkage cracks. If the coke pieces are large when formed, they will usually be found to consist of bundles of slender pieces which tend to break apart upon handling. The formation of coke of this type is not limited to coals having any particular ultimate analysis. Coals with a volatile content ranging from at least 28 to 37 per cent may exhibit this behavior. The cause of the very dense structure appears to lie in the existence of certain physical conditions during the coking process.

Most of these coals respond very favorably to the addition of low-

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*C. J. Ramsburg and F. W. Sperr, Jr., "By-product Coke and Coking Operations," Jnl. Franklin Inst., 183 (1917), 391-430.

†O. O. Malleis, "By-product Coke Cell Structure. Ind. and Eng. Chem., 16 (1924), 901.

‡R. and S. Standard.

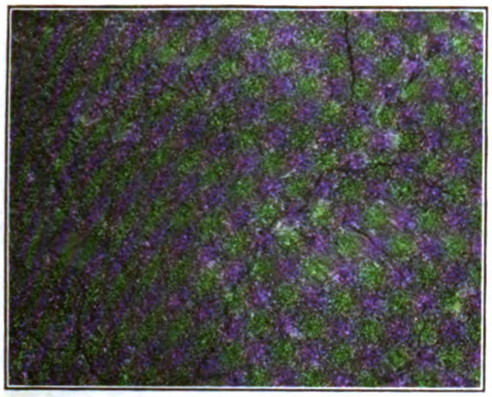

FIG. 16—Longitudinal section of box-test coke. Made in by-product oven from 17 per cent volatile-matter coal, Pocahontas No. 3 seam, McDowell County, W. Va. x 1.

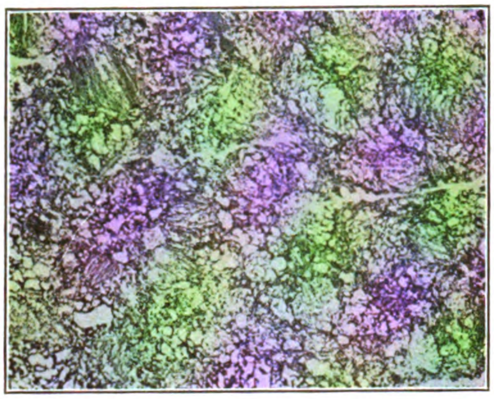

FIG. 19—Longitudinal section of by-product coke from 34 per cent volatile-matter high-oxygen coal, No. 6 seam, Franklin County, Ill. Filled with white composition. x 4.

volatile coal, and the mixture will usually give a much more open cell structure and larger, stronger coke pieces. The addition of enough low-volatile coal may largely or entirely prevent formation of longitudinal shrinkage cracks.

Large-cell Coke — Medium-volatile coking coals characteristically produce a strong, blocky, silvery gray coke, of strikingly uniform and handsome appearance. The cells of those cokes from coals approaching the low-volatile class are apt to be small and thin-walled, whereas those from coals approaching the high-volatile group, although apt to be small, are likely to have rather heavy cell walls. However, many medium-volatile coals, particularly those with about 26 per cent volatile content, give a coke with very large cells (No. 4),‡ of uniform walls (Figs. 22 and 23). Such coke exhibits few cross fractures, but when broken, the fractured surface is smooth and at right angles to the length of the coke piece. The fractured surface facing toward the oven wall is noticeably brighter in appearance than the other side of the fracture. The flattened shape of the cells cause an almost flaky appearance.

Other coals, particularly those with a volatile content around 34 per cent, have also been observed to give coke with large uniform cells and porous cell walls, but the flaky silvery appearance of the fractured surface is lacking (Figs. 24 and 25).

Coke with Cells of Medium or Irregular Size—Coals producing coke with cells of medium size may be considered as intermediate between certain of the coals mentioned above. Mixtures of dissimilar coals usually produce coke of this type.

Gas coals rather high in oxygen tend to produce coke with cells that average large but are irregular in size, wall thickness and general appearance. The

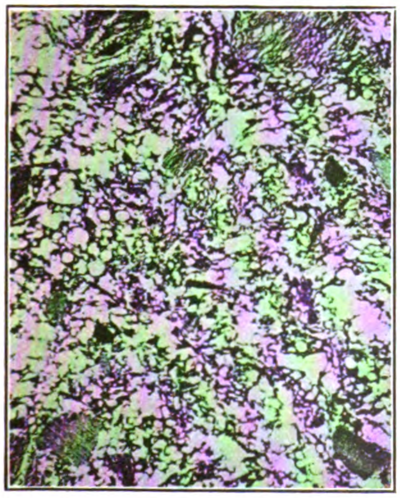

FIG. 17—Longitudinal section of Pocahontas 72-hour beehive coke, McDowell County, W. Va. Cells filled with white composition. x 4.

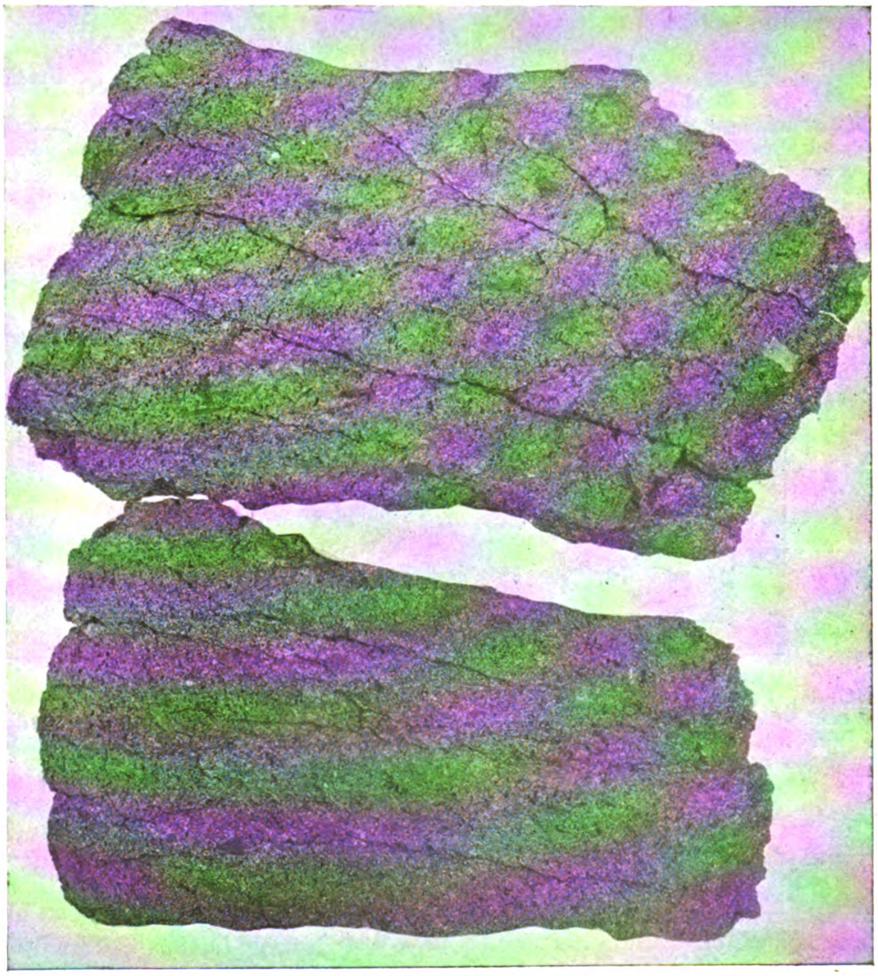

FIG. 18—Longitudinal section of coke made in Becker type ovens from 35 per cent volatile-matter high-oxygen coal, No. 6 seam, Jefferson County, Ill.

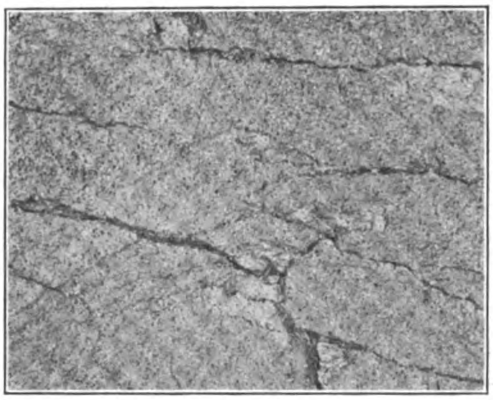

FIG. 20—Longitudinal section of by-product coke from 37 per cent volatile-matter slack coal, Pittsburgh seam, Monongalia County, W. Va. x 1.

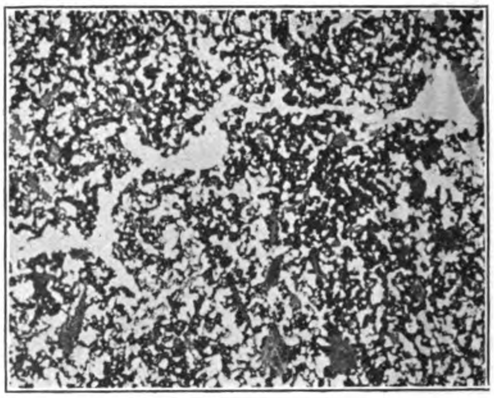

FIG. 21—Longitudinal section of by-product coke from 32 per cent volatile-matter coal, Pittsburgh seam, Westmoreland County, Pa. Cells filled with white composition. x 4.

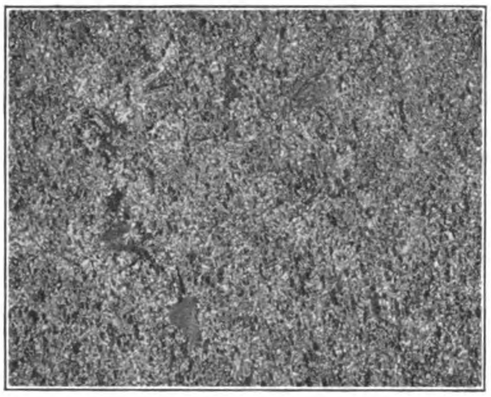

FIG. 22—Longitudinal section of by-product coke from 26 per cent volatile-matter coal, "B" seam, Fayette County, Pa. x 1.

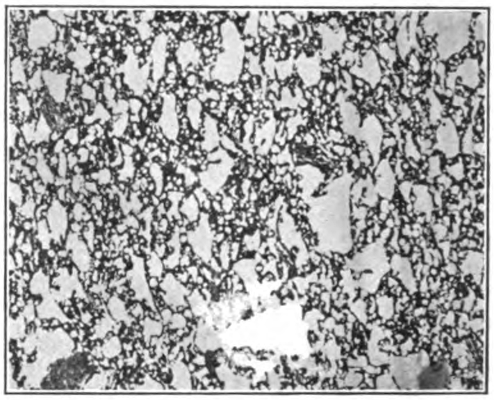

FIG. 23—Cell structure of by-product coke made from 25 per cent volatile-matter mixture of Upper Freeport and Kittanning seam coals, Northern West Virginia. Cells filled with white composition. x 4.

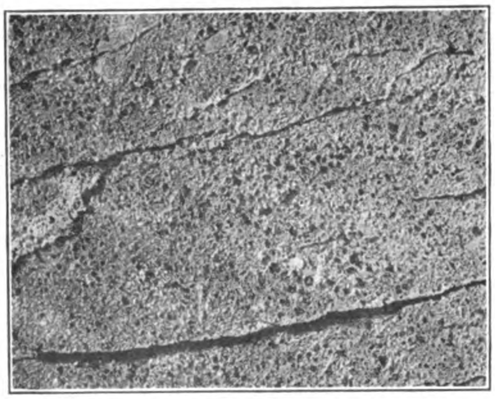

FIG. 24—Longitudinal section of by-product coke from 34 per cent volatile-matter gas coal, Taggart seam, Wise County, Va. x 1.

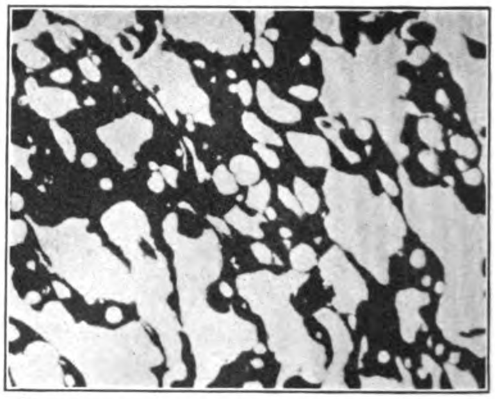

FIG. 25—Longitudinal section of 72-hour beehive coke made from high-volatile coking coal, Pittsburgh seam, Fayette County, Pa. Cells filled with white composition. x 25.

individual constituents of banded coal usually possess different coking properties, and thus give rise to an irregular cell structure.

Low and high-volatile coals differ considerably in fusing temperature and physical behavior when heated. When such coals are to be coked together, a good degree of pulverization and thorough mixing is necessary to get the full value of the low-volatile material which is added (Fig. 27).

An Extended Range of Coals Can Now Be Commercially Coked—The most interesting and important fact brought out by the preceding discussion of coking coals, is that a very wide range of coal types are now available for the manufacture of by-product coke. Recent important advances in coke-oven design have greatly simplified the problem of coal selection. In most places a variety of coal acceptable for use in the modern ovens are available. Coal selection is a matter

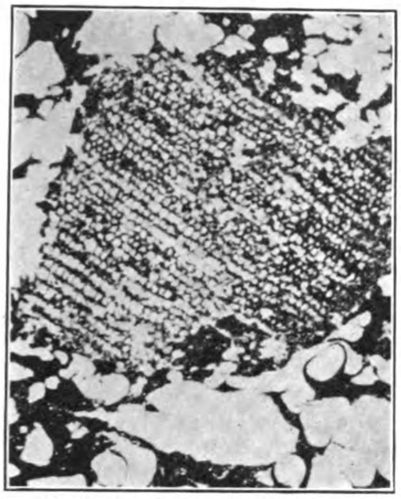

FIG. 26—Carbonized "mineral charcoal" (Fusain) cross section in Pocahontas 72-hour beehive coke, McDowell County, W. Va. Cells filled with white composition. x25. Mineral charcoal is a non-coking constituent.

of choosing the coal or coals that appear to offer the most advantages. Even in isolated localities, where there is little or no choice among bituminous coals, a coke of satisfactory physical properties can usually be produced.

Yields and Value of Gas and By-products.

The 49,000,000 tons of coal carbonized in by-product coke ovens in 1924 gave the yields* shown in Table 2.

TABLE 2

By-products Obtained from Coke-oven Operations in 1924.

Coke-oven gas	Total Production	Average Yields per net Ton Coal
Used at coke-ovens, M. cu. ft.	239,897,197	
Used in steel or affiliated plants, M. cu. ft.	187,171,883	
Distributed through city mains, M. cu. ft.	65,676,867	
Used under boilers, etc., M. cu. ft.	29,794,046	
Sold for industrial use, M. cu. ft.	18,561,057	
Total gas produced, M. cu. ft.	541,101,050	11,030
Tar, gal.	422,074,326	8.6
Ammonium sulphate (equivalent of all forms of ammonia produced), lb.	1,089,245,167	22.2
Crude light oil, gal.	128,956,955	*2.9

*Average for plants recovering light oil.

Table 3 gives the average annual value† of the products sold during a 3-year period.

TABLE 3

Average Value of Gas and By-products Sold During 1922, 1923, 1924

Coke-oven gas	Cents	Cents	Cents
Used in steel or affiliated plants, M. cu. ft.	11.0	11.3	11.2
Distributed through city mains, M. cu. ft.	35.7	35.5	35.8
Used under boilers, etc., M. cu. ft.	6.5	5.4	5.8
Sold for industrial use, M. cu. ft.	10.7	20.7	19.2
Tar, gal.	4.0	4.4	4.6
Ammonium sulphate, lb.	2.5	2.9	2.4
Crude light oil, gal.	12.3	10.5	8.3
Motor benzol, gal.	19.1	16.3	15.2

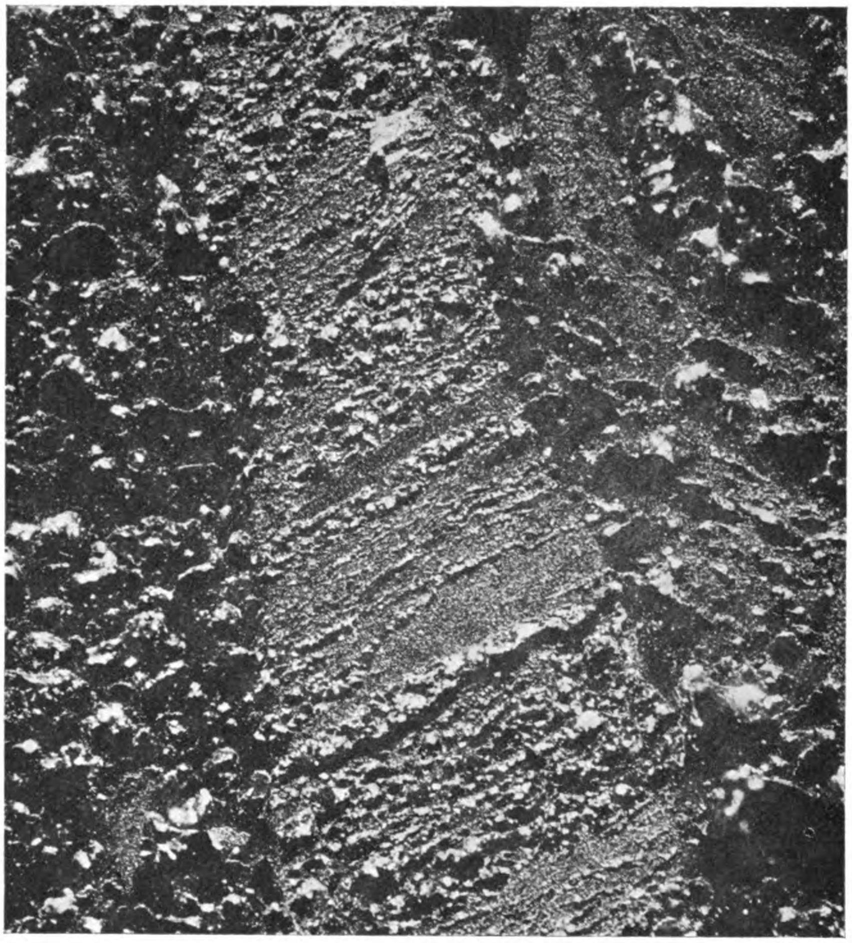

FIG. 27—Result of poor pulverization of a mixture of 80 per cent Pittsburgh seam coal with 20 per cent Somerset County, Pa., low-volatile coal. The central area is coke formed from a fragment of low-volatile coal surrounded by coke formed chiefly from the high-volatile constituent. x 18.

Coke comprises about two-thirds of the total products of coal carbonization, both in value and in weight. The most variable characteristic of the coals used, is the coking property, and it is not surprising to find that coals for by-product coke ovens are selected primarily on the basis of the yields and quality of the coke, or coke and gas, which they will produce. By-product yields are also important, but, in general, this factor is of secondary importance in coal selection, except when it is necessary to choose between coals of similar coking properties.

It is impossible to generalize satisfactorily on the by-product yields obtainable from coal, because of the considerable range in chemical composition of the coals of each class discussed and because by-product yields also depend on operating conditions. Furthermore, coals even from the same mining district may possess marked individualities.

The by-product yields obtainable from many coals and coal mixtures under particular operating conditions, have been established by long use, but for unfamiliar coals, special methods must be used to determine the yields. Separate by-product recovery apparatus has sometimes been attached to single test ovens located in the regular oven batteries of coke plants, but this method has not met with much favor as a practicable and reliable test.

In the writer's opinion,* the most satisfactory method is the distillation of coal in the laboratory, under conditions which duplicate actual coke-oven

(Continued on page 409)

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*Production of By-product Coke and of By-products in 1924. U. S. Geol. Survey.

†U. S. Geol. Survey Reports.

Research in Metallurgical Literature

The Author Outlines the Procedure to Be Followed in Making a Research into Metallurgical Literature—List of Periodicals and Magazines Given as a Guide

By RICHARD RIMBACH*

THERE is no more important phase of technical work in metallurgy than that indicated by the above title. Thus, whether the metallurgist is concerned with the acquirement of a comprehensive knowledge of the properties of any particular metal or combination of metals for research or technical purposes, or again with matters relating to patent litigation, the ability to search the literature rapidly, thoroughly and efficiently is of prime importance, and of no lesser importance is the saving in time and money in preventing the "new" discoveries of old facts.

The "new" discovery of old facts is clearly illustrated by the two examples given below:

1—In Prussia about 1857 it was proposed to build a blast furnace with a rectangular hearth and in 1858 a description of an oblong furnace designated as "Patent Alger" was published in the "Mechanics Magazine" (London.)

Elliptical and rectangular furnaces were built in the Teploya-Gora-Lyssensky mining district, Ural, Russia in 1882.

In 1901 and again in 1910 oval furnaces working on charcoal are described in Stahl und Eisen. Furnaces of this type using coke as fuel were built in Newport, England and in Muehlheim, Germany. In time all these furnaces were again replaced by the circular type as they did not show much advantage and it was more difficult to charge the burden and collect escaping gases.

In the Iron Age of February 12, 1925 a change in hearth design is recommended from the round to elliptical and heralded as new.

2—About 1891 a paper was given before the Iron and Steel Institute detailing experiments made with different shapes of ingot molds to get the best shape for a large forging ingot. In conclusion a certain type of ingot which had been found most satisfactory was described.

There is nothing more in the literature until 1902 when another paper was read before the Institute again describing extensive tests, and the results gave the very same type ingot and ingot mold. In the discussion of the paper one of the men brought out that his company had also carried on extensive work and had been using this type of ingot since 1889.

In 1917 the companies manufacturing large forging ingots experienced considerable difficulty and in each case after extensive and expensive research found the same type of ingot as was discovered in 1889, 1891 and 1902.

If a thorough search of the literature had been made the latest discoveries in the above would not have been given out as new.

In the first place, in order, that the metallurgist may be thoroughly equipped to carry out an investigation of the literature, it is necessary that he be able to read both German and French, if in addition he possesses some knowledge of Russian and Italian, so much the better. (A very good technical dictionary in six languages edited by Alfred Schlomann and published by R. Oldenbourg, Munich is Illustrierte Technische Woerterbuecher in 16 volumes. Volume 11 is especially for Metallurgy.)

The method of conducting a search of metallurgical literature will vary depending on the subject of the research. In general the first procedure is to go through the books listed below:

Production of Metals.

"General Metallurgy," Hofman.

"An Introduction to the Study of Metallurgy," Roberts-Austen.

"Metallurgy of Common Metals," Roberts-Austin.

"Principles of Metallurgy," Fulton.

"Lehrbuch der Allgemeinen Huettenkunde," Schnabel.

And a variety of special books on individual metals as:

"Copper Smelting," Peters.

"Metallurgy of Copper," Hofman.

"Kupfer," Borchers.

"Kupfer-Legierungen," A. Krupp.

"Metallurgy of Lead," Collins.

"Metallurgy of Lead," Hofman.

"Metallurgy of Lead," Percy.

"Metallurgie des Zinns," Mennicke.

"Metallurgy of Tin," Louis.

"Metallurgy of Zinc and Cadmium," Ingalls.

"Zink und Cadmium," Max Liebig.

"Gold," Rose.

"Mining and Metallurgy of Gold and Silver," Phillips.

"Metallurgy of Silver and Gold," Percy.

"Metallurgy of Silver, Gold and Mercury," Egleston. Two volumes.

"Metallurgy of Aluminum and Aluminum Alloys," Anderson.

"Aluminum und Aluminum Legierungen," Berg.

"Aluminum," Richards.

"Aluminum," Mierzinski.

"Das Aluminum," Krause.

"Aluminum Industrie," Winteler.

"Cobalt—Its Occurance, Metallurgy, Uses and Alloys," Drury. (Ontario Bureau of Mines.)

"Nickel," Bureau of Standards, Circular 100.

"Nickel," Borchers, Report of the Royal Nickel Commission, Canada.

"Zirconium," Bureau of Mines, Bulletin 186.

"Manganese," Bureau of Mines, Bulletin 173.

"Molybdenum," Bureau of Mines, Bulletin 111.

"Uranium, Radium and Vanadium," Bureau of Mines, Bulletin 70.

"Metallurgie des Wolframs," Mennicke.

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*Metallurgist, Pittsburgh, Pa.

Iron and Steel.

"The Manufacture and Properties of Iron and Steel."

"The Metallurgy of Steel," Harboard and Hall. Two volumes.

"The Metallurgy of Iron," Turner.

"Iron and Steel," Tieman.

"Taschenbuch fuer Eisenhuettenleute," Huette.

"Handbuch der Eisennhuettenleute," Ledebur.

"Handbuch der Eisen- und Stahl Giesserei," Geiger. Two volumes.

"Steel Foundry," Hall.

"Making, Shaping and Treating of Steel," Camp and Francis.

Properties of Metals and Alloys.

"Metallography," Hoyt. Three volumes.

"Metallography," Desch.

Metallographie," Guertler.

"Metallographie," Goerens.

"The Elements of Metallography," Ruer-Mathewson.

"An Introduction to the Study of Metallography and Macrography," Guillet and Portivin.

"Lehrbuch der Metallographie," Tamman.

"An Introduction to the Study of Physical Metallurgy," Rosenhain.

"The Science of Metals," Jefferies and Archer.

"Physikalische Chemie der Metalle," Schenk.

"Chemical Combination Among Metals," Giua.

"Alloys and Their Industrial Applications," Law.

"Crystallization of Metals," Belaiew.

"The Fatigue of Metals," Gough.

"Metals and Their Alloys," Vickers.

"Metals and Metal Compounds," Evans. Four volumes.

"The Microscopic Analysis of Metals," Osmond and Stead.

"Etudes des Alliages Metalliques," Guillet. Two volumes.

"Les Methodes d'etudes des Alliages Metalliques," Guillet.

"Treatise on Brasses, Bronzes and Other Alloys and Their Constituent Metals," Thurston.

"Iron, Steel and Other Alloys," Howe.

"Die Legierungen," Ledebur-Bauer.

"Metallurgy of Steel," Howe.

"The Metallography of Steel and Cast Iron," Howe.

"The Physico-Chemical Properties of Steel," Edwards.

"Physikalische Metallographie," Heyn.

Cast Irons.

"Das Schmeidbare Eisen und Gusseisen," Oberhoffer.

"Das Gusseisen, Seine Herstellung, Zusammensetzung, Eigenschaften und Verwendung," Mehrtens.

"American Malleable Cast Iron," Schwartz.

"Cast Iron in the Light of Recent Research," Hatfield.

"Das technische Eisen," Oberhoffer.

"Cast Iron," Keep.

"Principles of Iron Founding," Moldenke.

Blast Furnace for Pig Iron.

"Blast Furnace Construction," Johnson.

"Principles, Operation and Products of the Blast Furnace," Johnson.

"Blast Furnace and the Manufacture of Pig Iron," Forsythe-Meissner-Mohr.

"Beitraege zur Hochofentheorie," Juepter von Jonstorff.

"Combustion in the Gas Producer and the Blast Furnace," Korevaar.

Open Hearth.

"The Open Hearth Furnace," Windett.

"Der Basisch Herdofen prozess," Dichman.

Electric Steel Melting Furnace.

"Electric Furnace for Iron and Steel," Stansfield.

"The Manufacture of Electric Steel," Sisco.

"Die Elektrostahloefen," Russ.

"Elektrische Oefen in der Eisenindustrie," Rodenhauser and Schoenawa.

Heat Treating.

"La Cementazione Dell'acciaio," Giolitti.

"The Case Hardening of Steel," Brearley.

"Steel and Its Heat Treatment," Bullens.

"Metallography and Heat Treatment of Iron and Steel," Sauveur.

"The Heat Treatment of Tool Steel," Brearley.

Ingots.

"Ingots and Ingot Molds," A. W. and H. Brearley.

Alloy Steels.

"Die Edelstaehle," Rapatz.

"Metallographic Study of Tungsten Steels," Hultgren.

"Recherches sur les Aciers au Nickel a Hautes Teneurs," Dumas.

"Die Specialstaehle," Mars.

"Molybdenum, Cerium and Related Alloy Steels," Gillet and Mack.

"High Speed Steel," Becker.

"Les Application des Aciers au Nickel," Guillaume.

Fuels.

"American Fuels," Bacon and Hamor. Two volumes.

"The Utilization of Low Grade and Waste Fuels," Goodrich.

"Wirtshaftliche Verwertung der Brennstoffe," Grahl.

"Modern Gas Producers," Rambush.

"Coal Carbonization," Porter.

"Fuels and Their Combustion," Haslam and Russel.

Rolling.

"Walzen und Walzenkalibrieren," Tafel.

"Le Laminage du fer," Geuze.

"Das Kalibrieren der Walzen," Brovot.

Heating Furnaces.

"Industrial Furnaces," Trinks. Two volumes.

"Regenerativ-Gasoefen," Toldt-Wilcke.

"Le chauffage Industriel," Le Chatelier.

"Refractories and Furnaces," Havard.

"Generatoren und Martinoefen," Jueptner.

In experimental work, much planning is required for a comparatively small amount of work, yet it cannot be curtailed with safety, for such curtailing might render the experimental work useless. Of even greater importance is a search to determine whether the whole problem has been solved previously.

For information regarding titles and dates of publication of books, articles, etc., on metallurgy and allied subjects the following general indexes should be consulted:

"Publishers Weekly," American Catalogue of Books.

"Bibliography of Bibliography on Chemistry and Allied Technology," Clarence J. West and D. D. Berolzeimer. (Bulletin 50, National Research Council.)

"Bibliography on Research," National Research Council, Division of Engineering and Industrial Research.

"Special Libraries Directory," May Wilson and Rebecca B. Rankin.

"United States Catalogue," Wilson & Company.

"Journal of the Chemical Society of London Abstracts," published by the Society.

"International Catalogue of Scientific Literature," published by the Royal Society.

"Glazebrook's Dictionary of Applied Physics."

"Thorpe's Dictionary of Applied Chemistry."

"Repertorium der Technischen Journal Literatur."

"The Engineering Index," published by the American Society of Mechanical Engineers.

"Review of Iron and Steel Literature," E. H. McClelland. Printed by the Carnegie Library, Pittsburgh.

"Review of Coal Industry Literature," E. H. McClelland. Printed by the Carnegie Library, Pittsburgh.

"Notes on the Progress of the Home and Foreign Iron and Steel Industries," Journal of Iron and Steel Institute.

"Review of Metallurgical Literature," published monthly in Stahl und Eisen.

"Bibliographia Chimica."

"Bibliographia Technica."

"Industrial Arts Index," published by H. H. Wilson Company.

"Science Abstracts"—Sec. A, "Physics;" Sec. B, "Electrical Engineering," published by the Institution of Electrical Engineers and the Physical Society of London in co-operation with the American Institute of Electrical Engineers and the American Physical Society.

"Chemical Abstracts," published by the American Chemical Society.

"Berichte der Deutschen Chemischen Gesellschaft."

"Chemisches Centralblatt," Repertorium fuer Reine, Pharmaceutische, Physiologische und Technische Chemie."

"Physikalische Berichte."

"Technische Zeitschriftenshan."

Mention should also be made of the Library Service Bureau of the National Engineering Societies in New York City. The National Research Council maintains a research information service.

In general the next procedure would be to go carefully through the yearly indexes of the list below, which, though laborious, enables a thorough search to be made. If as a result of this review a still more thorough and complete one is deemed necessary, the following journals should be carefully abstracted:

Metallurgical Publications.

"American Foundrymen's Association Transactions."

"American Institute of Metals Transactions."

"American Institute of Mining and Metallurgical Engineers," Mining and Metallurgy.

"American Iron and Steel Institute Yearbook."

"American Society for Steel Treating Transactions."

"American Society for Testing Materials Proceedings."

"Assn. Technique de Fonderie."

"Birmingham Metallurgical Society Journal." (England.)

"British Cast Iron Research Association Bulletin."

"Canadian Institute of Mining and Metallurgy Bulletin."

"Canadian Mining Institute Journal."

"Carnegie Scholarship Memoirs."

"Chemical and Metallurgical Society of South Africa."

"Deutsche Gesellschaft fuer Metallkunde, Zeitschrift."

"Eastern States Blast Furnace and Coke Association."

"International Association for Testing Materials Proceedings."

Institute of Mining and Metallurgy Journal." (London.)

"Iron and Steel Institute Journal."

"Kaiser Wilhelm Institute fuer Metallforshung zu Berlin-Dahlem, Mitteilungen aus dem Material Pruefungsamt."

"Kruppische Monatshefte."

"Koenigliches Material Pruefungsamt."

"Materialpruefunganstalt in Darmstadt, Mitteilungen."

"Materialpruefungsanstalt an der Eigen. Techn. Hochschule zu Zurich, Mitteilungen."

"Metallurgical Division of the Research Department," Woolwich, England.

"Missouri University School of Mines and Metallurgy, Bulletin."

"North of England Institute of Mining and Mechanical Engineers."

"Oberschlesischen Berg- und Huettenm. Verein Zeitschrift."

"Research Group News."

Sheffield Foundry Trades Technical Society."

"Society Mining Industry Bulletin."

"Southern Ohio Pig and Coke Association."

"Staatlichen Technischen Versuchsamtes Mitteilungen," (Vienna.)

"Staffordshire Iron and Steel Institute."

"University of Leeds, Fuel and Metallurgical Reports," (England.)

"United States Bureau of Mines, Circulars and Technical Papers."

"United States Bureau of Standards, Circulars, Scientific Papers, Technologic Papers and Technical News Bulletins."

"United States Watertown Arsenal, Reports of Tests of Metals."

"Verein deutscher Eisengiessereien."

"Verein deutscher Eisenhuettenleutte, Berichte der Fachausschuesse."

"Verein deutscher Giessereifachleute."

"West of Scotland Iron and Steel Institute Journal."

Trade Journals.

"Berg- und Huettenmaennisches Jahrbuch."

"The Blast Furnace and Steel Plant."

"Brass World and Plater's Guide."
"Canadian Chemistry and Metallurgy."
"Canadian Foundryman."
"Canadian Mining Journal."
"Central Blat fuer Huetten und Walzwerke."
"Chemical and Metallurgical Engineering."
"Chemical Engineering and Mining Review."
"Die Giesserei."
"Engineering and Mining Journal Press."
"Ferrum."
"Forging-Stamping-Heat Treating."
"Foundry."
"Foundry Trade Journal."
"Giesserei-Zeitung."
"Internationale Zeitschrift fuer Metallkunde."
"Iron Age."
"Iron and Coal Trades Review."
"Iron and Steel Engineer."
"Iron and Steel of Canada."
"Iron Monger."
"Iron Trade Review."
"Le Fonderie Moderne."
"La Metallurgia Italiana."
"Metal und Erz."
" Metal Industry," (New York.)
"Metal Industry," (London.)
"Metallurgist—Supplement to Engineer," (London.)
"Metallurgie."
"Messager Ind. Metaux Russe."
"Montanistische Rundschau."
"Revista Minera, Metallurgia Y de Ingenieria."
"Revue de Metallurgie."
"Revue Universelle des Mines.'
"Stahl und Eisen."
"Steel and Metal Digest."
"Vestnik Metalloprom'islennosti," (Russia.)
"Zeitschrift fuer das Berg-, Huetten- und Salinenwesen im Preuss. Staate."
"Zeitschrift fuer die Gesamtegiessereipraxis."
"Zeitschrift fuer Metallkunde."

Electro-Metallurgy—Journal of Societies and Companies.

"Association of Iron and Steel Electrical Engineers Journal."
"A-E-G-Mitteilungen."
"American Electrochemical Society Transactions."
"American Institute of Electrical Engineers."
"Elecktrotechnische Verein," (Vienna.)
"General Electric Review."
"Institute of Electrical Engineers," (London.)
"Mitteilungen der Vereininung der Elektrizitaetswerke."
"Siemens Zeitschrift."

Trade Journals.

"Electric Journal."
"Electrical Review."
"Electrical World."
"Electrician."
"Elektrotechnische Zeitschrift."
"Revue Electrochimei."
"Zeitschrift fuer elektrochemie und angew. Physikalischechemie."
"Elektrotechnik und Maschinenbau."
"Electric Times."

Fuels, Furnaces, and Combustion-Journals of Societies.

"American Gas Association Proceedings."
"American Society of Heating and Ventilating Engineers Journal."
"Brennkrafttechnischen Gesellschaft Jahrbuch."
"Monats.-Bulletin Schweiz."
"Gesellschaft fuer Braunkohlen und Mineraloelforschung."
Institution of Petroleum Technologists Journal."
"Institution of Gas Engineers of Great Britain."
National Fuel Research Station at East Greenwich."
"Department of Fuel Technology of Scheffield University."
"Verein Gas und Wasserfachm."
"Kaiser Wilhelm Institute for Coal Research."
"Institute of Brown Coal Research at Freiberg."

Trade Journals.

"American Gas Journal."
"Archiv fuer Waermewirtschaft und Dampfkessekwesen."
"Braunkohle."
"Brennstoff Chemie."
"Coal Age."
"Colliery Guardian."
"Combustion."
"Colliery Engineering."
"Chaleur et Industrie."
"Fuerfest."
"Fuerungstechnik."
"Fuels and Furnaces."
"Fuel in Science and Practice."
"Gas and Oil Power."
"Gas Age-Record."
"Gas Journal."
"Gas World."
"Gas Engineer'.'
"Gas und Wasserfach."
"Industrial Gas."
"Power."
"Power Plant Engineer."
"Steam Coal Buyer."
"Die Waerme."
"Die Waermewirtschrift."
"Waerme und Kaelte Technik."

Ceramics and Refractories.

"American Ceramic Society Journal."
"Berichte der deutschern Keramischen Gesellschaft."
"Cermaist."

The Metallurgist will naturally be guided by such questions as the nationality and location of the men who have worked in the particular field as to the probable source of references covering the particular subject, so that very frequently much time may be saved by consulting such journals immediately without going through the whole of those specified above.

In order that metallurgist may keep up to date it is advisable that he read regularly at least four or five journals, for example:

1—"Yearbook of the American Iron and Steel Institute.
2—"Journal of the Iron and Steel Institute."
3—"Transactions of the American Institute of Mining and Metallurgical Engineers."
4—"Transactions of the American Society for Steel Treating."
5—"Stahl und Eisen."

Recovery of Phenols from Gas Liquors

The Author Describes a Substantially Improved Process for the Elimination and Recovery of Phenols from Crude Ammonia Liquors—Regenerative Throughout

By ROBERT M. CRAWFORD*

A PREVIOUS article by the writer† describes the removal and recovery of phenols from coke plant ammonia liquors by a continuous, counter-current process, involving benzol as a cyclic extraction medium. The article describes the use of caustic soda solution for recovering the phenols as sodium phenolate from the circulating benzol and the neutralization of the phenolate by means of carbon dioxide gas, or more lately crude sodium bi-carbonate, for the generation of a solution of sodium carbonate as a by-product for use in desulphurizing coke oven gas by the liquid purification process.

The Troy, N. Y., plant mentioned in the article has been continuously operated since and the following data pertaining to it can be given:

The average extraction efficiency of phenols from the crude ammonia liquors under normal routine operation which is now in vogue it at least 95 per cent—extraction efficiencies have been recorded as high as 99 per cent where conditions were particularly favorable. The use of carbon dioxide gas for neutralizing the sodium phenolate and liberating the free phenols has been discontinued and crude sodium bicarbonate is being used; first, because the neutralization with bicarbonate can more quickly be conducted and second, because the amount of spent sodium carbonate solution generated more nearly reaches the total make-up needed to supply the liquid purification unit.

Spent Solution Increases Efficiency.

A totally unexpected increase of gas purification efficiency has been noted at the liquid purification plant when using the spent carbonate solution from the phenol plant—whereas the normal efficiency when using purchased soda ash is usually about 85 per cent, the efficiency, when using the spent carbonate liquors from the phenol plant, will run 90 per cent and has given as high as 95 per cent. The precise explanation for this phenomenon has not been determined but it would appear, since phenolic bodies markedly lower the surface tension of solutions, that the presence of a small quantity of free phenols in the spent carbonate liquors permits a better contact between the foul solution and the activating air in the activating tower, giving a more thoroughly activated solution which, in turn, would promote more efficient absorption of hydrogen sulphide in the purifying tower.

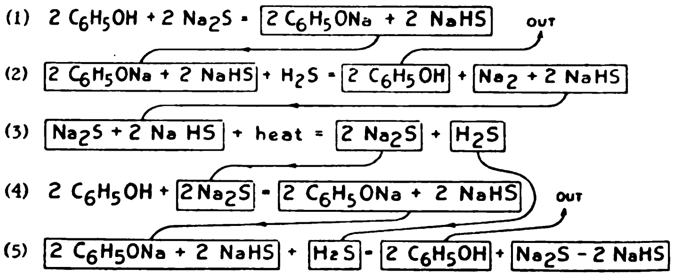
The consumption of raw materials at Troy comes within the figures given in the writer's previous article. One man easily operates the plant on a 10-hour shift and the part time of a chemist is required on routine tests. Over 2,000 gal. of crude phenol has been recovered for sale since the plant has been operating, the crude product being of a quality from which purified products can be easily distilled without the need for preliminary process steps to remove interfering impurities such as naphthalene, dissolved benzol, pyridine bases, neutral oils, etc.

Process Substantially Improved.

The particular purpose of the present article is to describe a substantial improvement in the process which makes it self-contained, regenerative throughout and which practically eliminates the purchase of caustic soda and bicarbonate as process materials.

Hydrogen sulphide gas can just as easily be used to neutralize the phenolate as CO_2 gas or bicarbonate. The spent liquor remaining in this case, after decanting off the free phenols, consists mainly of a mixture of sodium sulphide (Na_2S) and sodium hydro-sulphide (NaHS), when heated or steam distilled, the spent liquor decomposes into sodium sulphide (Na_2S) and hydrogen sulphide (H_2S) gas, which can obviously be separated and collected. The sodium sulphide solution thus generated will react with phenols to form sodium phenolate as easily as caustic soda and it thus is seen that the alkaline absorbing medium is always regenerated for reuse, making a cyclic system at this portion of the process. Another cycle also is apparent since the H_2S generated by decomposing the spent liquors is always regenerated for liberating the free phenols from later phenolate solution.

The following reactions will clarify the regenerative system just described:



(1) $2\,C_6H_5OH + 2\,Na_2S = \boxed{2\,C_6H_5ONa + 2\,NaHS}$ OUT

(2) $\boxed{2\,C_6H_5ONa + 2\,NaHS} + H_2S = \boxed{2\,C_6H_5OH} + \boxed{Na_2 + 2\,NaHS}$

(3) $\boxed{Na_2S + 2\,Na\,HS} + \text{heat} = \boxed{2\,Na_2S} + \boxed{H_2S}$

(4) $2\,C_6H_5OH + \boxed{2\,Na_2S} = \boxed{2\,C_6H_5ONa + 2\,NaHS}$ OUT

(5) $\boxed{2\,C_6H_5ONa + 2\,NaHS} + \boxed{H_2S} = \boxed{2\,C_6H_5OH} + \boxed{Na_2S - 2\,NaHS}$

Equation 1 shows the absorption of the phenol in sodium sulphide solution.

Equation 2 shows the liberation of the free phenol by acidifying the products of Equation 1 with H_2S gas.

Equation 3 shows the decomposition of the spent liquor from Equation 2 regenerating the sodium sulphide solution and H_2S gas.

Equation 4 is a repetition of Equation 1 using the sodium sulphide solution product of Equation 3 to absorb additional phenol.

Equation 5 is a repetition of Equation 2 using the hydrogen sulphide gas product of Equation 3.

Regenerates Sodium Sulphide for Absorption.

It is obvious that the above series of reactions is a double cycle which regenerates the sodium sulphide for phenol absorption as well as hydrogen sulphide gas for phenol liberation. It is not possible, of course,

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*Chemical Engineer, The McAleenan Corporation, Pittsburgh, Pa.

†The Blast Furnace and Steel Plant, March 1926.

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to operate such a cyclic system commercially without losses which must be made up; the small mechanical losses are, therefore, made up by the addition of very small quantities of caustic soda solution and hydrogen sulphide gas. Caustic soda solution for make-up is easily supplied from purchased material, or by causticizing a quantity of soda ash—unfortunately the use of spent H_2S gases dissipated from a liquid purifier stack cannot economically be used to supply the H_2S requirement on account of the low concentration and the presence of large quantities of air which would promote the formation of poly-sulphides. However, the amount of make-up H_2S required is so small as to be considered almost negligible and it is convenient to use H_2S from cylinders or from a small generator using iron sulphide.

With the installation of the new regenerative system just described, the phenol recovery system can be operated at the average coke plant to slightly more than pay for operating charges, interest, depreciation and maintenance from revenues derived from the sale of the crude phenol recovered as a by-product.

Patents covering the above recovery system are issued and pending.

Stokers for Billet Heating Furnaces

A Brief Description of a Stoker Installation on a Billet Heating Furnace—Scaling and Coal Consumption Greatly Reduced—Furnace Capacity Increased

By C. H. LAWRENCE*

A STOKER operated furnace for heating billets ranging in sizes from 8 in. x 3 in. x 40 in. to 3 in. x 3 in. x 56 in., was recently installed at the Elyria, Iron & Steel Company, Elyria, Ohio. The billets are heated and then rolled down to strips from 8 inches to 3 inches wide and to thickness of from 6 to 14 gauge.

Two rows of billets are pushed into the furnace by a charging machine over water cooled skid pipes which extend the full length of the furnace to the hearth. The heated billets are pushed transversely out of the furnace to a conveyor which takes them to the rolls.

A cross section of this furnace with the stoker is shown in Fig. 1. The distance from the charging to the discharge end of the furnace is 30 ft. This portion of the furnace is 12 ft. wide with a sprung arch roof. Fig. 2 is a side view of the furnace showing the charging end, the push-out door and the stoker. A view at the discharge side with a billet on the conveyor passing to the rolls is shown in Fig. 3.

In spite of the severe conditions under which the stoker has to operate for this class of service the results are very gratifying. The average output of the furnace is 6.5 tons of steel per hour. At this rate of production the stoker burns 260 lbs. of coal per ton of steel heated or 27 lbs. of coal per sq. ft. of grate surface with forced draft at a pressure corresponding to 0.45 inches of water under the fire and zero draft over the fire. A temperature of 3000 deg. F. is maintained over the fuel bed and 2800 deg. F. over the hearth. The steel leaves the furnace at 2500 deg. F. and the gases leave the charging end of the furnace at 1800 deg. F.

Scale Greatly Reduced.

In billet heating work scale is an important factor. The scale itself represents a direct loss while the presence of scale on the steel passing through the rolls represents an indirect loss due to a rough and inferior grade of finished product. Therefore, it is essential that the amount of scale be kept to a minimum.

Scale is caused by free oxygen coming in contact with iron at high temperatures forming iron oxide. In billet heating furnaces this free oxygen is present in the furnace gases from two sources, either it is drawn into the furnace from the outside, or it is present because of an improper mixture of products of combustion.

For the first condition free oxygen is reduced to a minimum by operating with zero draft in the furnace or even with a very slight pressure over the

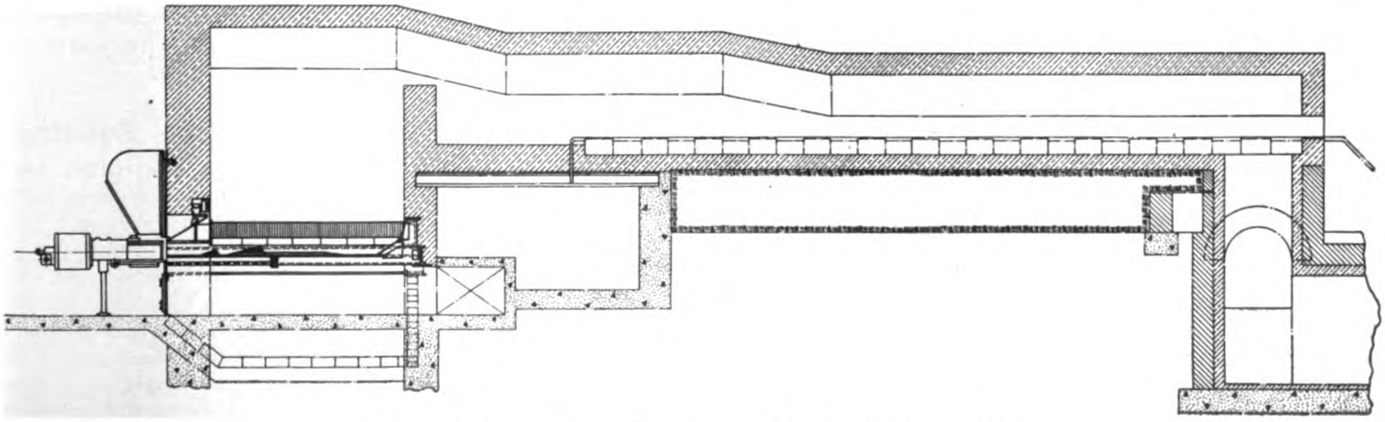

FIG. 1—Cross-section of stoker-fire billet heating furnace.

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*Westinghouse Electric & Manufacturing Company.

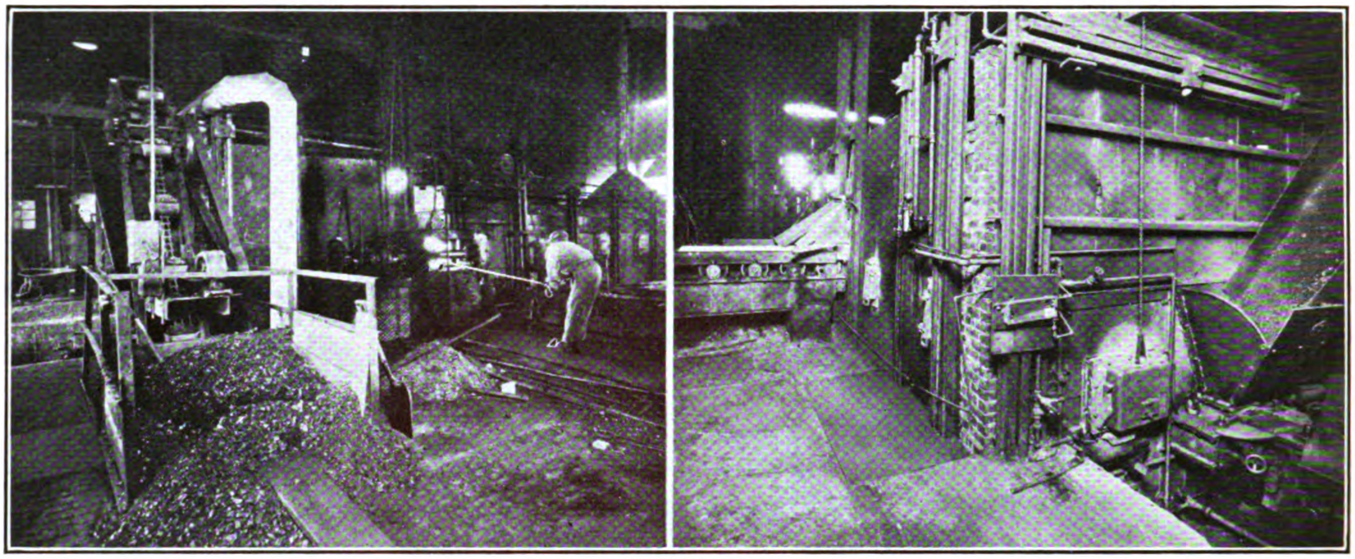

FIG. 2 (Left)—Side view of furnace showing charging end, push-door and stoker. FIG. 3 (Right)—Discharge side of furnace with billet on the conveyor passing to the rolls.

hottest part of the furnace, thus preventing an infiltration of air.

For the second condition the complete and proper mixture of products of combustion is brought about by the stoker itself, by maintaining a uniform fuel bed over the entire grate and admitting air to all parts in proportion to the rate at which the combustible gases are liberated.

Fig. 4 shows a comparison of the scale produced on the billets with the hand-fired grates and that produced with stoker operation. This represents a reduction in scale of 30 per cent, which is a direct gain and does not include the gain due to a much smoother finished product as a result of less scale.

Due to the limitations of the roll capacity it is impossible to realize any increase in furnace capacity except as relates to continuity of service and a better quality of product which two factors have increased the tonnage about 10 per cent.

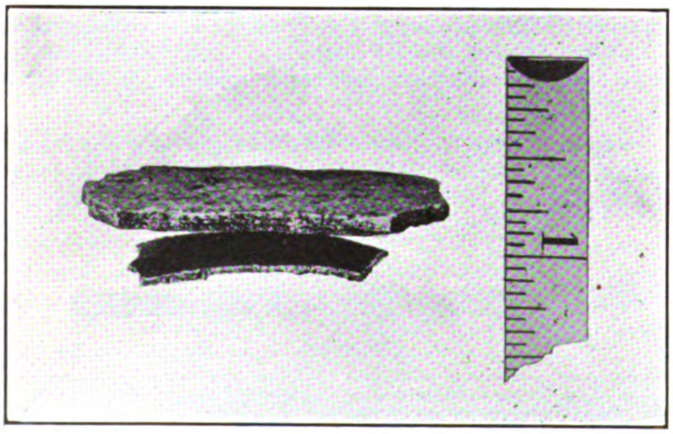

FIG. 4—Comparison of scale produced with hand fired grates (top) and stoker operation (bottom).

The stoker feeds the coal into the center of the furnace, moves it toward the dump grates at the side and deposits the refuse on the dump grates. The power operated dump grates permit the refuse to be removed frequently and easily without lowering the furnace temperature enough to slow up production, while with hand-firing it is practically impossible to clean the fire without retarding production.

Advantage of Stoker Firing.

The following advantages of stoker firing over hand firing have been noted:

1—Coal saving—approximately 20 per cent.

2—Reduction in scale—approximately 30 per cent.

3—Increased capacity—The furnace equipped with the stoker is able to provide heated billets for twice the roll capacity that was served with the hand-fired furnace.

4—Better quality of finished product—Billets are heated uniformly and thoroughly and, due to less scale, the finished product has fewer blemishes.

5—Ease of operation—The stoker requires about one quarter of the time of the one operator without the strenuous physical effort required by hand firing. One operator could take care of at least four stoker fired furnaces.

Rebuilds Open Hearth

On account of the increased tonnage demand it has become necessary for the Eastern Steel Company to increase its steel supply. Receiver Edward L. Herndon applied recently to the United States Court for authority to spend the necessary money to rebuild an 85-ton open-hearth which has been idle following considerable objection by one creditor. The court has granted the authority.

Work Started on National Press Building

Ironworkers have started to erect the frame work for the National Press Building, a fourteen story home and office building being erected at Washington by the National Press Club at a cost of approximately $11,000,000. The trusses and girders are the largest ever brought to Washington. They were fabricated in the Pittsburgh plant of McClintic-Marshall & Company. There will be 120 tons of reinforcing steel and 3,100 tons of structural steel used in the construction. Crawford-Weigel Company, Cleveland, are the subcontractors for the frame work.

Improved Shear for Cutting Blooms

Shears with Movable Top and Bottom Knives for Cutting Blooms Make It Unnecessary to Use Depressing Tables—Used Extensively in European Steel Plants

SHEARS with movable top and bottom knives are widely used in European steel works, but so far few have been installed in this country. Before explaining the action of the upcutting shears, the usual method of cutting a hot bloom or bar will be considered.

In the process of shearing, the bloom is brought between the knives (Fig. 1), the top knife lowers and shifts the part of the bloom in touch with it down a distance which is a little greater than the height of the bloom. The part of the bloom in contact with the fixed knife cannot follow this motion; therefore, a separation of the bloom takes place which is called shearing, (Fig. 2). It is obvious that the rollers supporting the downward moving section of the bloom must yield to this motion, and this led to the design of the so-called shear depressing tables. These tables, usually on the delivery side of the shear, are pivoted near their outer end, the other end ar the shear being counter balanced by weights or hydraulic cylinders. At each cut the balanced end of the table tilts down giving way to the motion of the bloom.

Shear depressing tables are comparatively complicated and the rough service to which they are subjected makes it difficult to keep them in good working condition. Therefore, a shearing process has been developed by Johann Hahn, Cleveland, which makes it possible to use a stationary instead of a depressing table. The five phases of operation of the upcutting shear are as follows:

1—The bloom is brought between the knives and rests on a support. (Fig. 3.)

2—The top knife moves down into firm contact with the bloom and presses it on the support. (Fig. 4.)

3—The bottom knife rises until its upper edge travels over the lower edge of the top knife a small distance, thus cutting the bloom. This distance (the overlapping of knives) should be constant or about constant at different heights of blooms. (Fig. 5.)

4—The bottom knife descends to its lowest position. (Fig. 6.)

5—The top knife rises and leaves the bloom free to pass on. (Fig. 7).

This working cycle can easily be obtained by a hydraulic shear, the top and bottom knife each being operated by a separate cylinder, as shown in Fig. 8. However, electrically driven shears are preferred to hydraulic shears and, therefore, this article will be confined to mechanical type of shears. Many difficulties were encountered as will be seen from the illustrations. The working principles are shown diagramatically, as a more detailed description is beyond the scope of this article.

With mechanical shears having the above working cycle, it must be possible to raise and lower the knives while they are oscillating one against the other. In other words, the knives are free to move up and down while counteracting. Such is the case with each type of shear described hereafter.

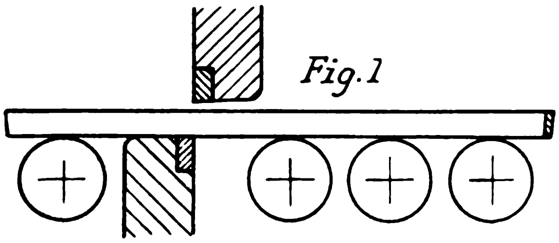
Fig. 1

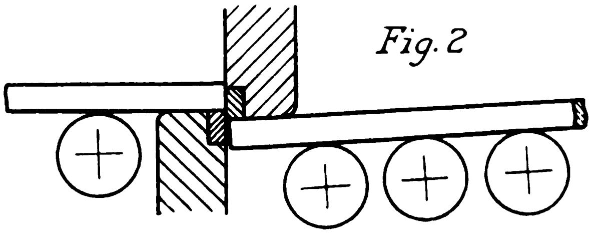
Fig. 2

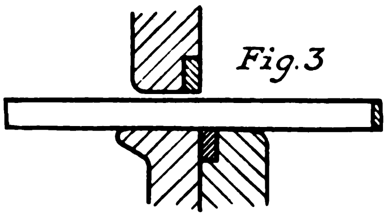
Fig. 3

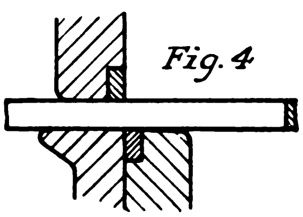
Fig. 4

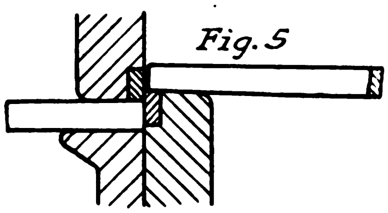
Fig. 5

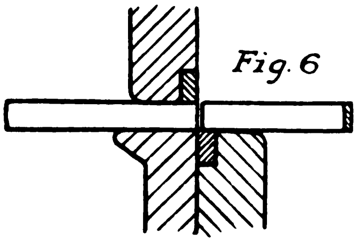
Fig. 6

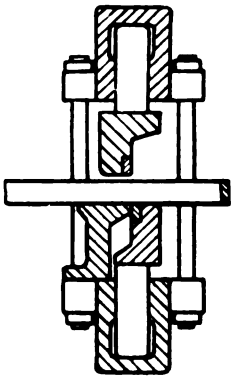
Fig. 8

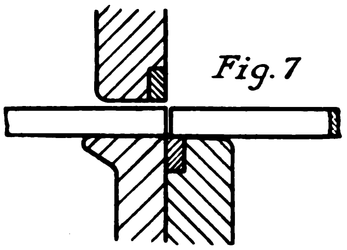
Fig. 7

FIGS. 1 and 2—Show the action of shears with depressing table. FIGS. 3 to 7—Illustrate the various operations in cutting a bloom with a shear having movable top and bottom knives. FIG. 8—Hydraulic shear with top and bottom knives, each knife being operated by a separate cylinder.

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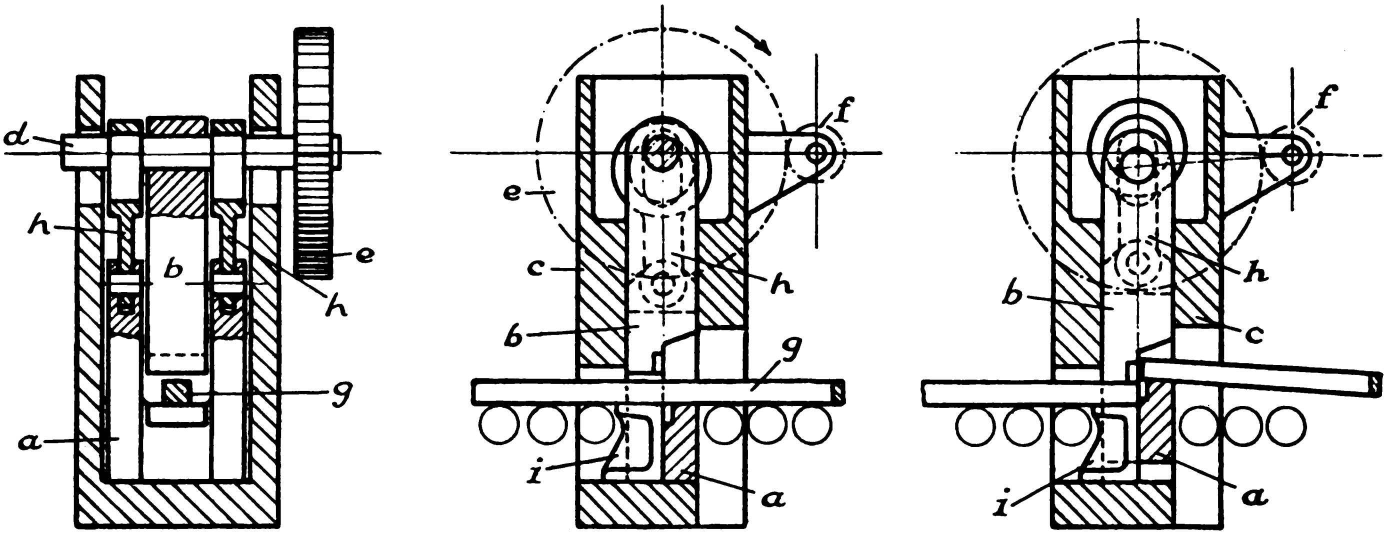


Fig. 9 *Fig. 10* *Fig. 11*

FIGS. 9, 10 and 11—The eccentric shaft and main gear in this type of upcutting shear are not stationary but move up and down with the lower knife holder.

On the shear shown in Figs. 9, 10 and 11, the bottom knife holder *a*, and the top knife holder *b*, can slide up and down in the shear housing *c*. The eccentric shaft *d*, which carries the main gear *e*, is held in the top knife carrier and follows this sliding motion. The main pinion *f*, with its shaft rests in a stationary bearing on the shear housing.

The cutting process is as follows: After the bloom *g*, has been entered, the main gear rotates in the direction of the arrow. The eccentric shaft, which is supported by the two connecting rods, moves down and carries with it the main gear *c*, the top knife and its carrier *b*. This motion is stopped when the top knife is in firm contact with the bloom and presses it on the support *i*. By continuing the rotation, the eccentrics, by means of rods *h*, raise the bottom knife carrier and knife, severing the bloom as shown in Fig. 11. The bottom knife and holder then lower again until the latter rests on the shear housing, whereupon the eccentric shaft with main gear and top knife holder lift into the initial position, thus freeing the bloom for transportation. While a number of these shears have been built in Europe, the fact that the eccentric shaft and the main drive gear are not stationary, but move up and down at each cut, is a disadvantage.

The shear shown in Fig. 12 has a stationary eccentric shaft or crankshaft and, therefore, a stationary main gear. In this type of shear the bottom.knife holder rests in the shear housing and holds levers, connecting rods and top knife carrier in place as shown. When the crank *k*, rotates in any direction, the upper lever turns around point *l*, and top knife carrier lowers until it rests on the bloom. The lever now turns around point *n*, and by means of rod *o*, lever *p* and link *q*, the bottom knife carrier *r*, and bottom knife rise and cut the bloom. Lever *p*, is pivoted in the shear housing at point *s*. As the crank continues to turn, the bottom knife carrier lowers until it rests in the shear housing; the point *l* becomes stationary, the top knife lifts off the bloom and allows it

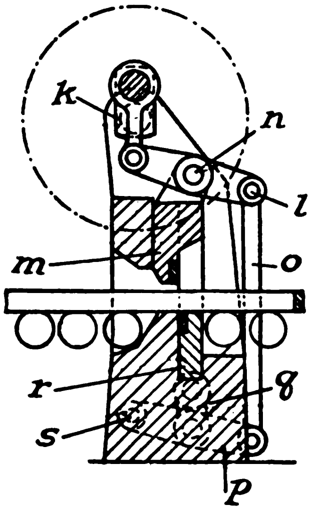


Fig. 12

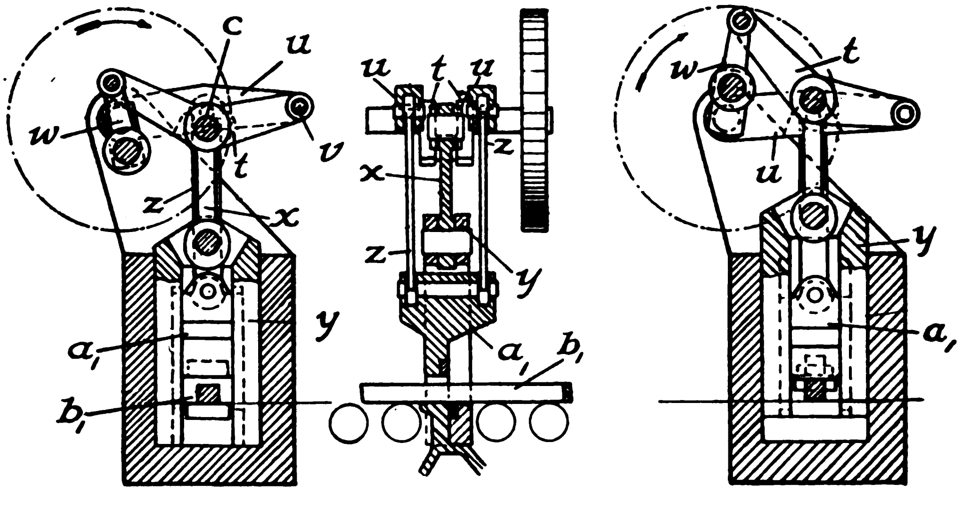


Fig. 13 *Fig. 14* *Fig. 15*

FIG. 12—Shear designed with stationary eccentric and main gear. Lower lever p, is exposed to water and scale.
FIGS. 13, 14 and 15—The knives of this type shear are free to move upward and donward while contacting.

to move on. Several shears of this kind are used in Europe and have the advantage of a stationary crankshaft. However, one lever is below the knives, being inaccessible and exposed to scale and water.

A number of shears with movable top and bottom knives, but without the disadvantage of the shears previously described, are shown in Figs. 13 to 19. The shear represented in Figs. 13, 14 and 15 has two levers, u and t, which are linked together at the point v. Lever u, consisting of two parts on either side of the crank, is pivoted on the crankshaft; lever t, is connected to the crank pin by rod w. Lever t, by means of tension rod x, is connected with the bottom knife carrier y, which rests on the shear housing. By means of compression rods z, lever u is connected with top knife carrier a. When the crank turns, the knives oscillate against each other, and at the same time point v, and, consequently, the knives may be raised and lowered. The knives are free to move up and down while counteracting. In detail the working cycle of this shear is as follows: Before the shearing operation the knives are open as shown in Figs. 13 and 14. The bottom knife carrier y, rests on the shear housing and is supported by means of the lever system. Bloom b_1, is entered and the main drive gear rotated in the direction of the arrow. Lever t, rocks round point c. Point v lowers and with it carries lever u, rods z, top knife carrier a_1, and top knife until the latter is in firm contact with the bloom and presses it on its support. This stops the downward motion of point v, and continued turning of the crank causes the rising of point c, rod x, the bottom knife carrier and the bottom knife, thus cutting the bloom as shown in Fig. 15. Up to this point, the crank has made about one half turn. In the other half the bottom knife descends to its lowest position, the top knife lifts and brings the shear back into its initial position.

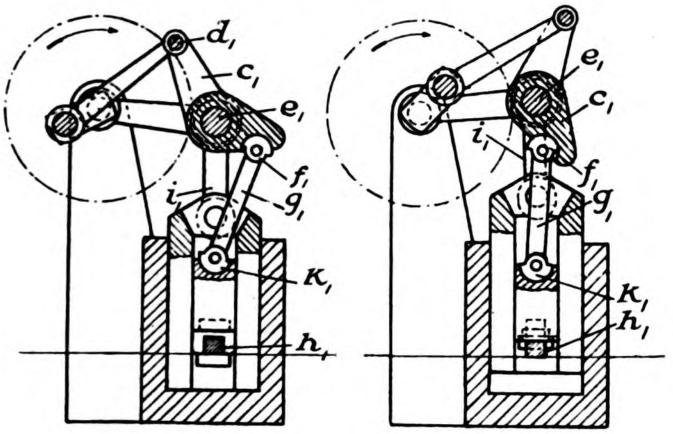


Fig.16 Fig. 17

FIGS. 16 and 17—Type of upcutting bloom shear which has all parts easily accessible.

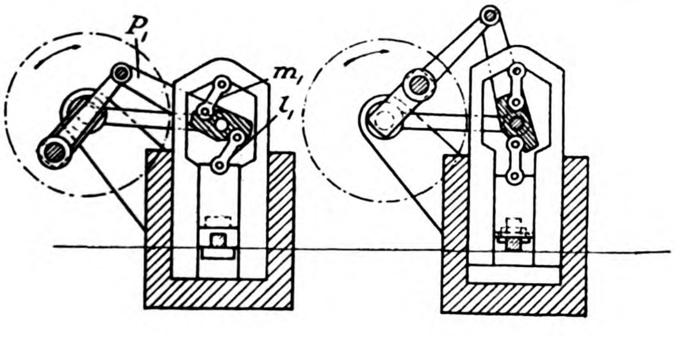


Fig. 18 Fig. 19

FIGS. 18 and 19—Upcutting shear of the same type shown in Figs. 16 and 17, but with the tension rod replaced by a compression rod.

Although this shear answers all conditions, a more simplified design, having but one lever instead of two, is illustrated in Figs. 16 and 17. Lever c_1 is linked at point d_1 to the crank pin; at point f_1, to the top knife carrier k_1, by link g_1, and at point e_1, to the crankshaft and the bottom knife carrier by i_1. When the crank turns in the direction shown, the lever c_1 rocks round point e_1, and point f_1, compression rod g_1, top knife carrier and top knife lower until the contact between the latter and the bloom h_1, stops this motion. Then as the crank turns further, point e_1 rises and with it tension rod i_1, the bottom knife carrier and the bottom knife. This performs the cutting of the bloom, the position at the end of the cut being shown in Fig. 17.

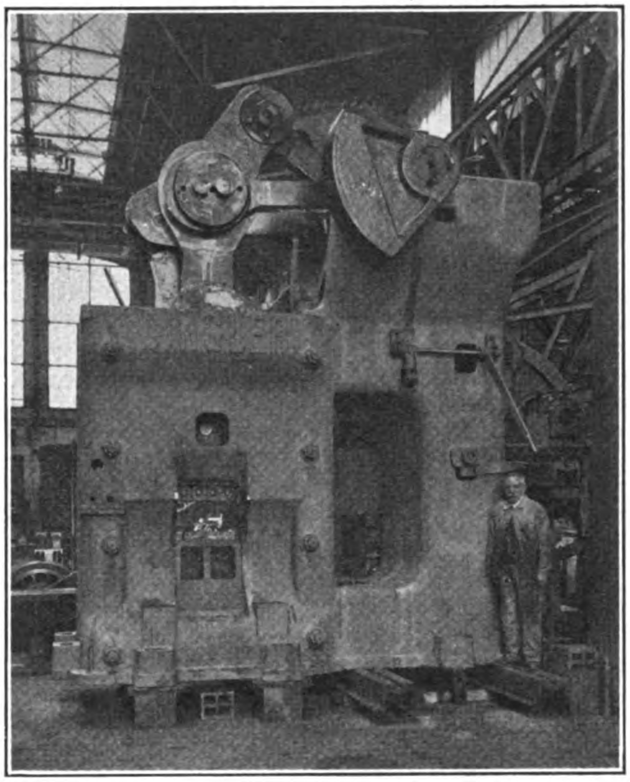


FIG. 20—Shear of the type shown diagrammatically in Figs. 16 and 17. A number of such shears are giving satisfactory service in Europe.

It will be noticed that in this figure the point e_1, f_1 and k_1, are about in a straight line. This is necessary in order to obtain about the same overlapping of the knife edges at the end of the cut for any height of the bloom. During the second half revolution of the crank the motion of the knives is reversed; the bottom knife lowers and the top knife lifts, thus completing the working cycle.

(Continued on page 410)

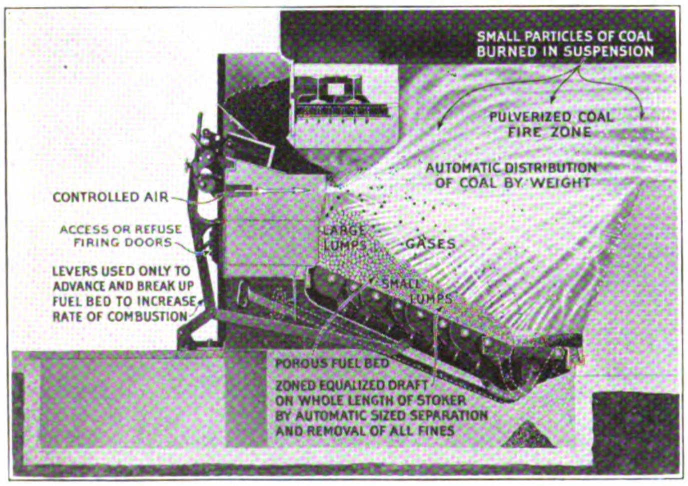
NEW EQUIPMENT SECTION

New Method of Burning Coal

The Pulverzone, the newest type of coal burning equipment is a product of the CoKal Stoker Corporation, Wrigley Building, Chicago.

The Pulverzone combines in one apparatus three approved methods of burning coal: 1—Pulverized coal burning; 2—spread method; and 3—coking method. In this way the Pulverzone is able to burn the smaller lumps and fines in suspension as with powdered coal burning. The heavier coal falls down at the front while the intermediate sizes are automatically spread over the rear section of the fuel bed. The standard coking method of the CoKal stoker is retained.

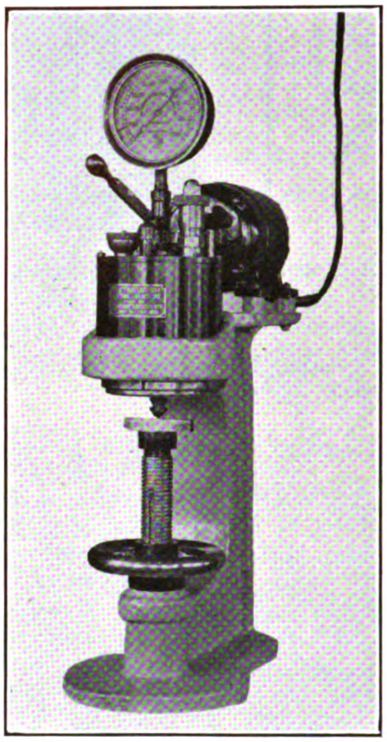
An ingenious method is employed by which the advantages of pulverized coal burning are obtained without the necessity for pulverizing the coal or drying it. Standard screenings are used, and lignite can also be burned very economically upon this equipment. By means of the CoKal turbulators, turbulence is obtained before, at and after ignition, with full utilization of furnace volume, resulting in high combustion efficiency and absence of smoke. The Pulverzone is capable of maintaining 12½ to 14½ per cent CO_2 at 350 per cent of boiler capacity. Such overloads are possible because of the complete ignition of the volatile, the intimate mixing of oxygen and gases and the partial combustion of the small coal in suspension. Another factor contributing to high capacity is that the fuel bed is always maintained porous because the small coal which ordinarily clogs up the grate is now burned in suspension. Another feature is that the larger lumps which catch fire while in motion are partially burned before they fall upon the fuel bed. In this way ashpit siftings have been eliminated and loss of unburned carbon minimized.


SMALL PARTICLES OF COAL BURNED IN SUSPENSION
PULVERIZED COAL FIRE ZONE
AUTOMATIC DISTRIBUTION OF COAL BY WEIGHT
CONTROLLED AIR
ACCESS OR REFUSE FIRING DOORS
LEVERS USED ONLY TO ADVANCE AND BREAK UP FUEL BED TO INCREASE RATE OF COMBUSTION
LARGE LUMPS
GASES
SMALL LUMPS
POROUS FUEL BED
ZONED EQUALIZED DRAFT ON WHOLE LENGTH OF STOKER BY AUTOMATIC SIZED SEPARATION AND REMOVAL OF ALL FINES

The outstanding advantages as given by the manufacturer are: Absolute smokelessness, abnormally high efficiencies, instantaneous response to load changes, large overloads, no pulverizing necessary, use of standard screenings (wet or dry), no explosion hazard, no slagging down, all cleaning periods eliminated, fires can be banked.

Motor-Driven Brinell Tester

A motor-driven Brinell machine has been designed by the Pittsburgh Instrument & Machine Company, Pittsburgh, Pa., for speedy inspection of large quantities of material. With the elimination of the controlling weights and the substitution of a control valve it is now possible to increase the number of tests per hour at least five times.



The rotary pump is made of bronze and steel with Timken ball bearings; and will stand up under the most severe working conditions. The stroke of the piston is more than ⅝ in. and the plunger returns quickly to its original position after each operation; that means, when testing specimens of uniform thickness the plunger has enough travel to allow for insertion and removal of specimen without the use of the hand wheel.

The pressure control valve is located on the right side of the cylinder. Glycerine is used in the reservoir, and is filtered through the funnel on the left. The tester is operated by an electric motor of 1/3 hp., either a.c. or d.c.. Belt-drive can also be arranged for, if desired. The speed in either case should be about 300 revolutions per minute.

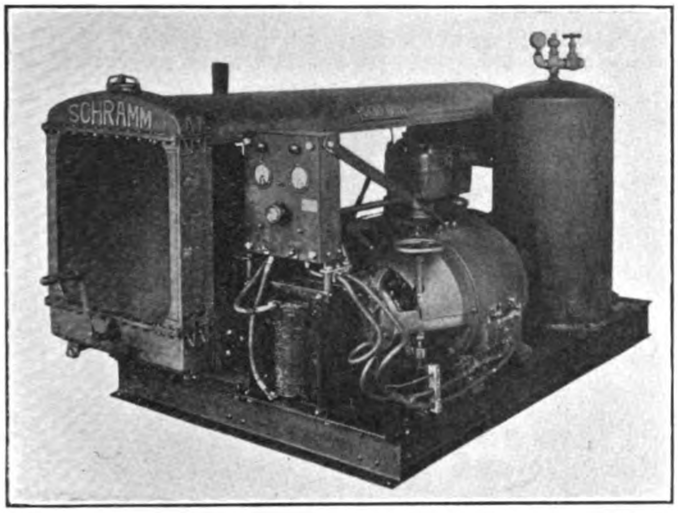
When tests are to be made, the material is placed on the screw table and brought into contact with the 10-millimeter steel ball. The handle is then forced down, closing the ball valve, and the maximum pressure of 3000 kilos is instantly reached. The handle is then released and the test piece removed and the next one inserted. Should circumstances require it, an attachment can be furnished to force down the handle by foot, thus giving the operator the use of both hands for handling specimens.

Like the hand-operated machine this power-tester is available in three sizes. The standard size will take test pieces up to 6½ inches, the next size has a gap of 12½ to 13 inches between the steel ball and screw table and the largest size will accommodate test pieces up to 18 and 20 inches.

Combination Compressor and Welder

A combination air compressor and arc welder driven by a gas engine and mounted on a single base has been placed on the market by Schramm, Inc., of West Chester, Pa. The outfit consists of a Buda gasoline engine, a Schramm compressor and a General Electric welding outfit. The complete equipment may be mounted on a standard two-ton truck or can be made portable by adding steel or rubber-tired wheels.

The Buda engine is a 24-hp., 800 rpm. unit which may be started and operated independently of either the compressor or welding generator. The Schramm compressor is a two-cylinder, water-cooled machine with a capacity of 120 cu. ft. per minute and equipped with an automatic unloading device. The air receiver is 16 inches in diameter by 42 inches high. The General Electric welding equipment consists of a belt-driven WD-12 arc welder with an idler pulley for belt tightening. By the use of a Borg & Beck 12-in. clutch coupling, either of the machines may be connected to the engine.



This combination outfit is expected to be of great value in field work. The air compressor can be used to operate drills, grinders and chipping hammers for cutting, peening, caulking and cleaning off scale. The compressor can also be used in preparing work for welding. With the General Electric WD-12 welder light and heavy gauge steel can be welded as well as cast iron. After the welding is completed, the compressor clutch is thrown and the weld can be ground or chipped as desired. Thus a complete job can be done with the single machine.

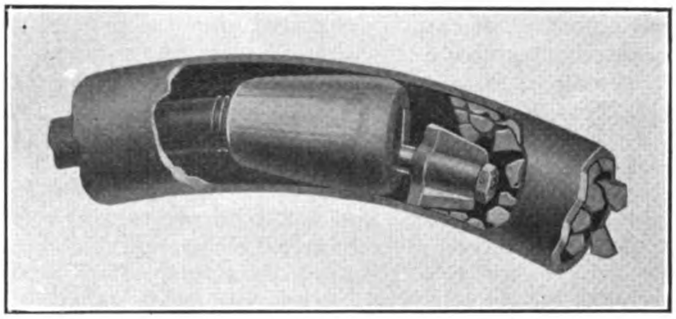
The structural steel base is 8 ft. 4 in. long, 5 ft. 11 in. wide. The outfit is 3 ft. 10 in. high. The total net weight of the outfit is 4,000 lbs.

Dean Boiler Tube Cleaner

Engineers generally appreciate the necessity of periodically removing scale or incrustation from their boiler tubes. A boiler whose tubes are incrusted cannot function properly. It wastes fuel, often falls down as a generator of steam and its tubes are apt to be continually overheated and to burn out and loosen at the header on account of heat-resisting, inelastic qualities of scale.

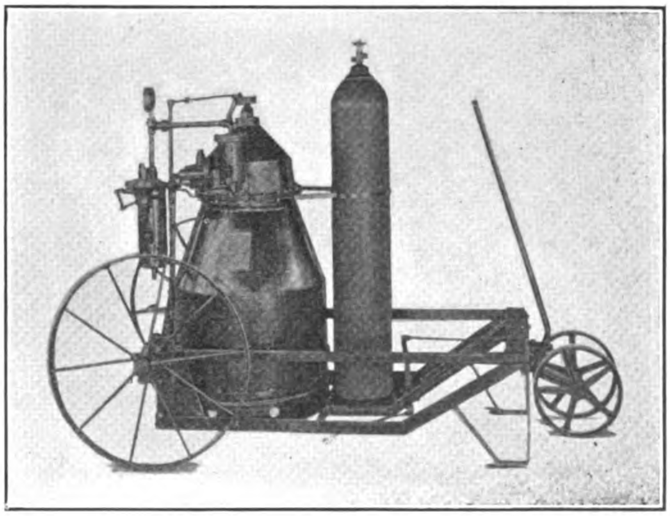
The Dean Universal Tube Cleaner, manufactured by the Wm. B. Pierce Company, 45 N. Division Street, Buffalo, N. Y., is a widely used tool for rapidly cleaning incrusted boiler tubes. It makes use of the contrast between the natures of scale and metal. It plays a rapid tattoo on the tube walls, thereby causing the metal to vibrate like the ringing of a bell. Scale is completely and quickly broken loose from the tubes.

It will be noted from the illustration that the cleaner can be operated in either water tube or return tubular boilers. In other words, scale is dislodged with equal effect, whether on the inside or outside of the tubes. If desired, the tool can be adapted for use in more than one size of tubes. It is also useful for removing hard baked soot from the water side of the tubes or, in fact, almost any kind of hard, troublesome lining that incrusts tubes or pipes for any purpose.



Portable Acetylene Generator

The Rego "P" Portable Generator manufactured by the Bastian Blessing Company, 240-258 E. Ontario Street, Chicago, Ill., is intended for use wherever acetylene is needed in the shop or out in the field. As portable generators are moved about in the open, subject to all sorts of weather conditions and rough usage, it is very important that they be simple in design and rugged in construction. Consideration of these points has led to the perfecton of Rego Portable Generators.



Generator shells are constructed according to Underwriters' Laboratories specifications. All seams are welded and recoated with solder on the inside above the water line. Carbide is fed into the water by the vibration of a feed valve, caused by means of gas bubbling up under the bell in a vibrator chamber. The feed is automatically controlled by a brake operated by a pressure diaphragm. An adjusting screw regulates the pressure—up to 15 lbs.—which is kept

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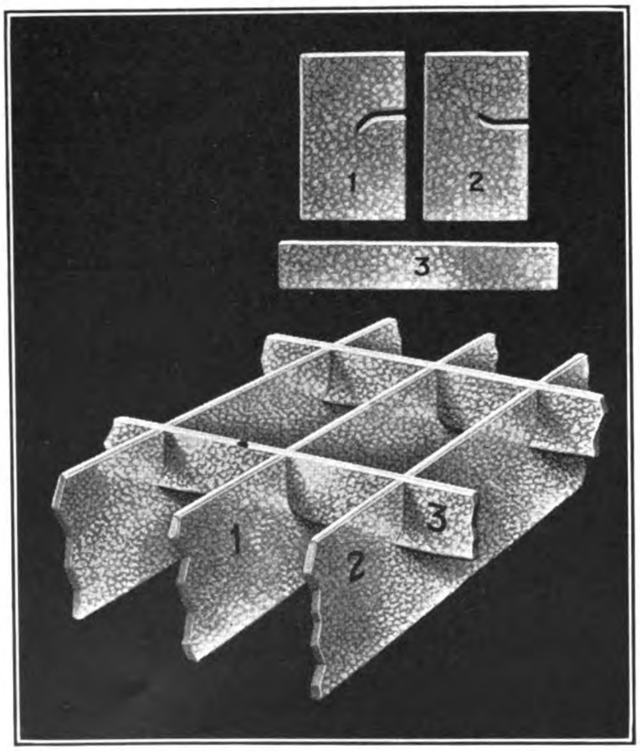
uniform. The carbide hopper is a single casting on which all the mechanism is mounted.

A large diameter reduces the height, and brings the center of gravity so low that it is almost impossible to upset it. Two blow-off valves, with capacities greatly exceeding the requirements, keep the pressure always under the prescribed mark of 15 lbs. Interlocking levers insure positive safety. In order to lower truck handle the feed mechanism must be locked, so that no acetylene can be generated until the generator is stationary and the truck handle once more raised.

Trucks of all welded steel are especially designed to bring the center of gravity low. Rear wheels are extra large to carry the bulk of the weight and to facilitate moving over rough ground. Rego "P" Portable Generators are made in two sizes. No. P-30 holds 30 lbs. of carbide and has a normal delivery of 30 cu. ft. of acetylene per hour, which is equivalent to the delivery of two 100 foot cylinders. No. P-60 holds 60 lbs. of carbide and delivers normally 60 cu. ft. of gas per hour, which is equivalent to the delivery of four 100 cu. ft. tanks. Both sizes can deliver at double their normal rate when emergencies demand.

Designs New Type Steel Grating

Tri-Lok Company, 5527 Butler Street, Pittsburgh, Pa., recently has placed on the market a new type of steel grating for platforms, floors and runways. The chief feature of this grating is that all joints are locked together under 1,600 tons pressure by a twist and turn method, securing great rigidity. All locking slots in the main bars are punched above the neutral axis, insuring maximum strength.



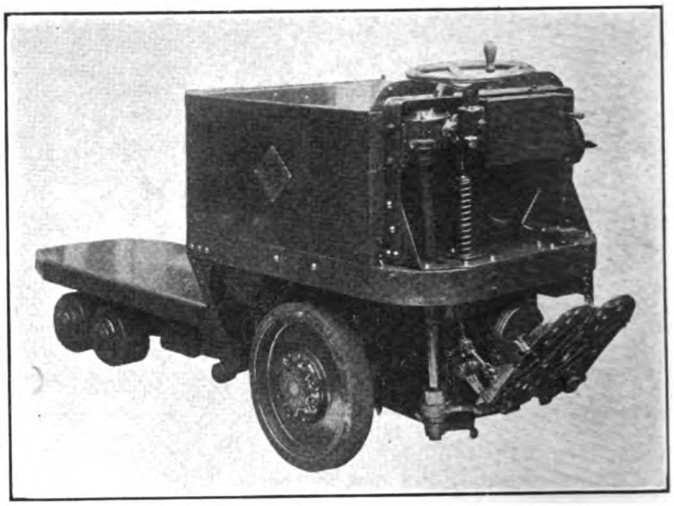
All the weight coming on the grating is carried directly by the main bars which are not cut, punched or otherwise deformed below the neutral axis and can therefore resist up to the yield point for the full cross-section of the bar. The curved slots in the upper half of the bars are filled solidly by the cross bars and hence the compressive resistance of the bars in bending is not altered or changed in any manner.

The angles formed by the main supporting bars and the transversal bars being 90 deg., greater freedom is afforded for rapid drainage where the grating is exposed to wetting. These wide angles also permit the free access of air for drying up moisture and prevent corrosion and rusting.

Provision for the free circulation of air and for the greatest amount of light transmission, has been secured by the use of cross bars of lesser depth than the main bars and by the form of joint between the main and transversal bars making possible the ommission of the edge bars. The form of the openings is conducive to cleanliness and facilitates painting.

Five-Ton Lift Tructor

The Ellwell-Parker Electric Company, Cleveland, Ohio, has added to their line, a new 5-ton Lift Mill Type Tructor. This unit resembles EP-6 in general and is provided with a 27½ x 60 x 11 inch platform to carry 5 tons. The load platform is of heavy steel plate with edges bent downward into a deep flange and welded at the corners. The end is tapered with upper corners rounded to assure easy entrance of skid without damage.



In transporting a heavy load the bulk of the increased capacity is imposed on the trail axle, consequently to facilitate the employment of this unit with 11½ inch high skids, it has been necessary to add two more wheels with tires and bearings for the distribution of the weight as the diameter and tread cannot be increased.

All four wheels steer simultaneously and all levers are over the axle and none are exposed either below or behind the axle. The two wheel axles are really one steel casting with heavier cross pin bearing in special steel casting anchored to tructor center sills. In traveling uneven floors the axle may rock. Each of the four wheels is fitted with a 10 x 6 tire and dust proof double roller bearing. Steering is by means of a 16 inch horizontal hand wheel at the left of the operator.

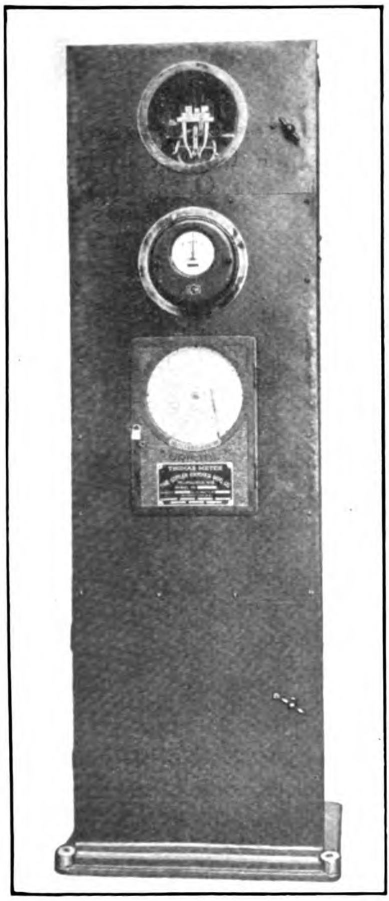
The differential on this unit is the heavy duty drop forged type. Interchangeable brake shoes are provided with lining removable by unscrewing the adjusting nut, and the brakes may be adjusted by one bolt. The frame construction is quite rugged and reinforced practically throughout its length by the long contact where the trail axle casting and the rear link brackets bolt and are riveted to it.

The lift switch which is of the drum type and located beneath the battery on the left of the truck is tripped by means of a rod attached to the platform near the ram connection. The adjustment for the trip is up beneath the battery deck and accessible from the side. The switch is manually operated by the indicating lever located on the right; the motion of the lever indicating the direction of motion of platform. The Tructor is provided with new heavy duty type controller with reverse drum that remains locked in off position until operator steps on one pedal. The main drum and reverse drum return to off position when the operator releases or steps off truck pedals.

The brake is set until the operator's weight depresses the brake pedal against the spring, and is applied when the operator steps off the tructor. The three point supported power plant consists of a heavy-duty type fully enclosed motor with all moving parts between it and the drive wheels of drop forged, heat treated alloy steel. An electric horn is provided as standard equipment. With this new Tructor, iron and steel, foundry and mill raw material and finished products may be stored and handled in large units outside of crane covered areas.

A New Gas Measuring Device

A new device for use by the smaller gas companies and for large customer service, where accurate measurement of gas flow is required, has just been brought out by the Cutler-Hammer Manufacturing Company.



It is called the Cutler-Hammer Thomas Meter and is made in sizes capable of measuring from 2,500 cu. ft. up to 200,000 cu. ft. per hour. The instruments show results in standard units, corrected for pressure and temperature. All corrections for pressure and temperature are made automatically, thereby eliminating mistakes. The instrument panel carries an integrating wattmeter with improved, easy-to-read dials; and a recording wattmeter which gives a graphic continuous record of the rate of flow for each 24-hour period. In customer service, this chart gives an accurate record for setting demand rate. The charts are the usual circular shape and can be conveniently filed with other records.

The instrument panel can be installed any place in the plant where records are most useful. Installation of the instrument panel is a simple matter as no special foundation is required. The meter housing is installed in the existing piping so that no special piping is necessary. The current regulator is incorporated in the instrument panel for convenience. The glass door in this panel facilitates inspection and easy access to all moving parts. Space is provided in the lower part for storage of ink, charts and tools. The work of installation therefore has been greatly simplified.

The new Thomas Meters are made in the following sizes:

For 110-volt A.C. Service	For 220-volt A.C. Service
25,000 cu. ft. per hour	100,000 cu. ft. per hour
50,000 cu. ft. per hour	150,000 cu. ft. per hour
	200,000 cu. ft. per hour

These sizes fill practically every need for industrial service. The equipment is extremely simple to wire, to operate and to maintain.

Develops Metal Suitable for Recuperators

Ludlum Steel Company, Watervliet, N. Y., has developed a tough rustless iron as a material for use in furnace recuperators. In one furnace employing 27 tubes in the metallic recuperators, the iron was made into tubes 4 inches outside diameter and 16 feet long with a wall thickness of 5/16 inch. The tubes were welded to manifolds on both ends by the oxy-acetylene method. Air at 5 ounces pressure is passed into the tubes from a box-shaped manifold and after absorbing heat from the hot gases surrounding the tubes is discharged through a similar manifold at the opposite end into a blast line leading to the burners.

The temperature of the air reaching the burners is about 700 deg. F. The temperature of the flue gases does not exceed 1,300 deg. on account of the furnace being of the continuous type in which part of the heat of the gases is absorbed in the chamber of the furnace by incoming cold material. The point at which the iron tubes begins to scale is several hundred degrees above this temperature. The furnace is equipped with two oil burners of the flat venturi type with atomization by compressed air. It heats 70 tons of 2-inch square billets to a rolling temperature of 2100 deg. F. in a 9-hour shift. The billets are pushed through the furnace by a mechanical pusher.

Pittsburgh Steel Company, Pittsburgh, Pa., has established an office in General Motors Bldg., Detroit, in charge of C. F. McLain.

Selection of Coals for Coke Manufacture

(Continued from page 395)

conditions as far as possible; the by-products are collected, and the yields determined.* It is rapid, reliable and requires but a small sample of coal. Long experience has proved that the success of this empirical test depends upon the rigid control of test conditions by chemists experienced in this work and frequent comparison of laboratory results with actual plant yields for the same coals.

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*H. J. Rose, "A New Electric Furnace for the Determination of the By-product Yields of Coal." (Unpublished.) Presented before the Gas and Fuel Section of the Amer. Chem. Soc., Pittsburgh, Pa., September 7, 1922.

Bibliography of Manganese Steel

(Continued from page 389)

Original in "Mittheilungen des Technologischen Gewerbemuseums in Wien, section für metall-industrie und elektrotechnik," 1886, p. 159.

Brief abstract of an article dealing with a steel containing 15 per cent of manganese, which can be magnetized only very slightly, and which is to be used in the construction of chronometers.

Urquhart, John W. Steel Thermal Treatment. 1922. Lockwood.

Manganese steel, p. 226-227.

[Use of Manganese Steel for Mine Car Wheels.] 1893. (In Engineering News and American Railway Journal, v. 30, p. 1.)

The same. 1893. (In Journal of the Iron and Steel Institute, v. 44, p. 516-517.)

Briefly states the advantages of manganese steel wheels.

Weeks, Joseph D. Hadfield's Patent Manganese Steel. 1884. (In Transactions of the American Institute of Mining Engineers, v. 13, p. 233-236.)

The same. 1885. (In Van Nostrand's Engineering Magazine, v. 32, p. 133-135.)

Deals briefly with the work of former investigators, and discusses properties and manufacture of manganese steel.

Weeks, Joseph D. Tests of Manganese Steel. 1886. (In Transactions of the American Institute of Mining Engineers, v. 15, p. 461-462.)

Gives the chemical composition and tabulates results of tests.

Welding of Manganese Steel. 1924. (In Journal of the American Welding Society, v. 3, no. 5, p. 10-23.)

What Clay Products Manufacturers Think of Manganese Steel. 1925. (In Brick and Clay Record, v. 67, p. 475-477.)

Improved Shear for Cutting Blooms

(Continued from page 405)

Although shears of the type shown in Figs. 16 and 17 are very simple in principle and have all parts easily accessible, nevertheless a number of changes had to be made in their construction; for instance the arrangement of tension rod i_1 on either side of the lever so that the compression rod g_1 could swing in between them. This led to the arrangement shown in Figs. 18 and 19. In principle it is the same as shown in the two preceding figures, except that tension rod i_1, Figs. 16 and 17, is replaced by a compression rod. The bottom knife carrier has been extended upward. By means of lever p_1, the compression rods l_1 and m_1, transmit the shearing force to the top and bottom knife carriers respectively. This arrangement makes it possible for the compression rods l_1 and m_1, to be located in one plane with lever p_1, which is the most desirable condition for the transmission of the shearing force. The working cycle of this single lever type of shear may be readily seen by following through one turn of the crank.

A very important feature of shears with movable top and bottom knives should not be left unmentioned. It is generally known that the ends of the bloom are more or less bent when cut with ordinary bloom shears, which is often very disagreeable and hard to remedy. On the "upcutting shears," especially those shown in Figs. 13 to 19, the top knife holds one end of the bloom down on the support with such pressure that it prevents it from bending and at the same time effects a straight cut. Furthermore, the "upcutting shears" make it possible to replace the shear depressing tables by stationary tables. The Mackintosh-Hemphill Company, Pittsburgh, Pa., has acquired the patent rights of this type of shear.

PERSONALS

H. S. Beale has been appointed sales engineer in the New York territory of the Harnischfeger Corporation, with offices at 50 Church Street, New York. H. A. Wolcott, formerly in charge of the company's Miami office, has been made district manager of the New York territory with headquarters at the same address. S. B. Bubier has been made sales engineer in the Miami district, with offices at 343 Southwest River Drive, Room 306, Miami, Fla.

* * *

William J. Adamson, formerly with the sales department of Trumbull Steel Company, Warren, Ohio, has been placed in charge of sales of hot and cold rolled strip steel for the Acme Steel Company, 112 West Adams Street, Chicago.

* * *

Crispin Oglebay, Oglebay, Norton & Company, Cleveland, a nephew of the late Earl W. Oglebay, has been elected a director of the Wheeling Steel Corporation, to fill the vacancy caused by the death of his uncle.

* * *

F. A. Whitten has been appointed engineer in charge of design and development for American Car & Foundry Motors Company, Detroit. Until his resignation some time ago he had been chief engineer for General Motors Truck Company, Detroit, having served in that capacity for 13 years.

* * *

E. H. Haslam has resigned from the Hadfield-Penfield Steel Company, Bucyrus, Ohio, of which he had been president for three years. He has also resigned as president of the Era Steel Company, an affiliated company. The operations of these companies are now in charge of W. A. Riddell, vice president. Mr. Riddell is president of the Frederick Iron & Steel Company and the Frederick Engineering Company, Frederick, Md. He will retain his interest in and continue his activities with the Frederick companies.

* * *

Wheeler Lord has been elected president of the Nicetown Plate Washer Company, Inc., Nicetown, Philadelphia. He founded the company in 1900 and left in 1917 to enter the Ordnance Department, United States Army, with the rank of major. The Nicetown Plate Washer Company, Inc., manufactures iron and steel bars, deformed bars, threaded rods with nuts, punched bars or plates, awning rods, step iron, cast iron washers, galvanized bars and washers.

* * *

R. H. Sproat has been appointed superintendent of the Newburgh Wire Works of the American Steel & Wire Company, effective August 1, to succeed A. W. Hitz, who will retire after 50 years' association with the wire manufacturing industry in plants of the American Steel & Wire Company, and their former owners in Cleveland. Mr. Sproat has been assistant superintendent of the Newburgh Wire Works and will be succeeded in that position by Charles Malone

Harry Hardwicke, for many years district manager, Chicago district, for Atlas Steel Corporation, Dunkirk, N. Y., has been elected a vice president of the corporation.

* * *

George H. Charls, president of the United Alloy Steel Corporation, Canton, Ohio, now a part of the Central Alloy Steel Corporation, has resigned. Mr. Charls was elected president of the United corporation in January this year to fill the office vacated nominally four years before by E. A. Langenbach, then chairman. Previously Mr. Charls had been vice president and general manager. He has spent 25 years in the iron and steel industry, 17 of which were with the American Rolling Mill Company, Middletown, Ohio, where he had been vice president and sales manager. He left that company to become vice president of the Stark Rolling Mill Company and Berger Manufacturing Company, Canton, Ohio.

* * *

W. W. Seabald, assistant vice president, American Rolling Mill Company, Middletown, Ohio, was elected a vice president at the directors' meeting, July 15.

* * *

H. H. Pleasance, vice president and general sales manager of the United Alloy Steel Corporation, Canton, Ohio, now a part of the Central Alloy Steel Corporation, has resigned to become affiliated with the Bourne-Fuller Company, Cleveland.

* * *

Ivan Stewart Forde, for many years manager of the small turbine division of the Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., and for the past three years manager of the sales promotion department of the Power Specialty Corporation, has resigned to join as sales manager the Furnace Engineering Company, New York, manufacturers of pulverizers.

* * *

Henry E. Smith has been placed in charge of sales as district manager at St. Louis for the Wheeling Steel Corporation, Wheeling, W. Va. He had been district manager at Atlanta for the LaBelle Iron Works in 1919 and since then for its successor, the Wheeling Steel Corporation.

* * *

J. Frederick Wiese, formerly with the Parkesburg Iron Company, Parkesburg, Pa., has been appointed assistant to the general manager of sales of the Lukens Steel Company, Coatesville, Pa.

* * *

W. B. Wallis, president of the Pittsburgh Electric Furnace Company, Pittsburgh, has recently returned from a two months' business trip to Europe, where he visited Sweden, France and Germany.

* * *

G. A. Singer, appointed Cleveland district sales manager with offices at 1056 Hanna Building Annex, Cleveland, for the Columbia Steel Company, Pittsburgh, formerly was in charge of the Cleveland office for the Sharon Steel Hoop Company, Sharon, Pa.

* * *

William J. Adamson, whose resignation as assistant to the president of the Trumbull Steel Company, Warren, Ohio, was announced recently, has joined the Acme Steel Company, Chicago, where he will have charge of hot and cold rolled strip steel sales. Mr. Adamson had been assistant general manager of sales at Trumbull before becoming assistant to the president.

* * *

W. J. Hammond has been appointed traffic manager, Inland Steel Company, succeeding the late C. L. Lingo. Mr. Hammond has been assistant traffic manager of the Inland Steel Company for the past eight years.

OBITUARIES

Robert Washington Ney, who has been identified with the wire manufacturing industry for 40 years and was manager of the Cleveland district wire mills of the American Steel & Wire Company for 17 years, died July 23 at his home in Cleveland. He was born February 22, 1855, in New York.

* * *

Franklin Silas Terry, vice president General Electric Company, and formerly co-manager of the company's National Lamp Works at Cleveland, died July 23 at his home at Black Mountain, N. C. He was 64 years old.

* * *

Ernst Reitler, well remembered in this country by all who attended the memorable meeting of the International Association for Testing Materials held in New York in the fall of 1912, died on June 17 after a long illness. He was in his sixty-fifth year. For more than a dozen years he was secretary of the testing association.

* * *

Kurt Huessener, president American Heat Economy Bureau, Inc., Pittsburgh, died suddenly of heart failure at Stresa, near Milan, Italy, August 7. Mr. Huessener, accompanied by his wife and son, was on a tour of Europe. He was born in Germany 47 years ago. For a number of years he was engaged in combustion engineering in England and came to the United States in 1915. He was the founder and organizer in 1922 of the company of which he was head at the time of his death.

* * *

Col. Washington A. Roebling, president of the John A. Roebling Sons Company, Trenton, N. J., and builder of the Brooklyn bridge, died at his home in that city, July 21, following a lingering illness brought on from infirmities of old age. He was 89 years old.

* * *

Oberlin Smith, formerly president of the American Society of Mechanical Engineers, and well known manufacturer and inventor of machinery died July 18 at Bridgeton, N. J. Mr. Smith was born in Cincinnati in 1840.

* * *

Sir John Roper Wright, V.D.J.P., D.L., died at Whitcomb Manor, Bath, on July 25, aged 83. He was a director and until 1925 chairman of Baldwins Ltd., and a director of many other South Wales iron, steel, coal, and tin plate companies. Jointly with the late Roger Beck, he established the Elba steelworks at

Gowerton. In 1865, under the direction of Dr. Siemen, he constructed the furnace in which the first ingot made by the Siemen Martin process was cast. Sir John had a large share in the building up of the great syndicate of Baldwins Ltd., one of the largest combines of the British steel trade.

* * *

John William King, of Eccleshall, Sheffield, who died recently, was for 40 years chief steelmaker at Brown Bayley's Steelworks & Company, Ltd., of Sheffield, operator of extensive works in Switzerland and France.

TRADE NOTES

The Rustless Iron Corporation, Baltimore, organized a number of months ago to take over the former plant of the Hess Steel Company, has been remodeling the works and will begin production for rustless and stainless iron specialties.

* * *

The Pyrotung Manufacturing Company, 730 West Fiftieth Street, Chicago, has been incorporated to conduct commercial and special heat-treating and allied operations. William R. Otis is president, with Charles E. Sutten, vice president. Charles E. Pynchon, formerly manager of the machinery and tool department of Joseph T. Ryerson & Son, Inc., is general manager. B. C. Cleveland, a graduate of Renssalaer Polytechnic Institute, heads the staff of metallurgical engineers. Charles T. Chance, formerly with the Colorado Fuel & Iron Company, at Pueblo, is superintendent of tests. The company has equipment for general heat treating and treating under what it calls the Pyrotung process.

* * *

The Atlas Steel Company, 1963 Elmwood Avenue, Buffalo, has taken out a permit for rebuilding one of its shop units recently destroyed by fire, to cost about $17,000.

* * *

The Maxee Company, 223 Fourth Avenue, Pittsburgh, has been incorporated and will have manufactured on contract the Maxee cutting device, which is for use in the cutting of steel with fuel gas and oxygen. The company does not contemplate the erection of a plant at present. J. McDonald McCutcheon is general manager.

* * *

Stockholders of the Central Steel Company, Massillon, Ohio, have approved by practically a unanimous vote the merger of that company with the United Alloy Steel Corporation, Canton, Ohio, into the Central Alloy Steel Corporation. The exchange basis is 2⅛ shares of United stock for one of Central.

* * *

Steelmaking in this territory continues at 80 to 85 per cent of capacity. The Republic Iron & Seel Company is operating at 80 per cent at Youngstown and the Bethlehem Steel Corporation's entire steelmaking is on an 85 per cent basis. The Carnegie Steel Company has started five additional open hearth furnaces at its Farrell, Pa., works, making all 15 furnaces there active. Industrial activity in the Farrell, Pa., district is at the highest point in two years. Steel Corporation units at Homestead and Duquesne are being operated at near-capacity.

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One of the largest industrial building contracts awarded this year was placed recently by the General Motors Company with the Austin Company, Cleveland, for a plant at Pontiac, Mich., for the Oakland Motor Car Company. Work was started July 23 on the plant which will have 2,000,000 square feet of floor space in a one-story, 445 by 880-foot motor plant, a three-story, 180 by 1260-foot assembly building, a 300 by 700-foot foundry and a car storage building 432 by 760 feet. Materials involved include 12,000 tons of structural steel, 500,000 square feet of steel sash, six miles of mechanical sash operating equipment, etc. Railroad siding and loading docks are to be constructed to accommodate 200 cars per day.

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Dominion Alloy steel Company, of Sarnia, Ont., is working at capacity, and is over 1,000 tons behind in orders, with business booked ahead for two months or more. New equipment will be installed at once to increase production capacity by 1,000 tons per month.

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The Mesta Machine Company has awarded a contract for two 10-foot automatic gas producers to the Chapman Engineering Company of Mt. Vernon, Ohio. The contract calls for the producers complete, and in addition the installation of the large header flue and cyclone soot legs, all completely equipped with clean-out doors, etc. This new producer plant is to be installed at the Benwood plant of the Wheeling Steel Corporation to serve a Chapman-Stein recuperative billet heating furnace being installed at the same time.

* * *

The Bethlehem Steel Company, Bethlehem, Pa., has active construction in progress on its proposed new pipe mill at the Sparrows Point, Baltimore, Md., plant, and will push the project to completion at the earliest possible date, now estimated from 12 to 15 months. The plant will represent an investment in excess of $10,000,000 and will be equipped to produce commercial pipe of practically every size, with rated capacity of about 18,000 tons per month. The new unit will adjoin a wire mill at the plant which was recently placed in service, erected in connection with the general expansion and improvement program adopted at this steel works a number of months ago. The wire mill has a rating of 140,000 tons of material per year. An additional blooming mill has also been constructed, doubling the capacity of this branch of the works. Three open hearth furnaces have also been constructed, doubling the capacity of this branch of the works. Three open hearth furnaces have also been completed. Work is now under way on additional tinplate mills to advance this department to a rating of more than 4,200,000 boxes per annum; it is purposed to have the additional units equipped and ready for service in the near future. Current construction also includes extensions in the sheet and jobbing mills to enlarge this unit of the works approximately 30 per cent over the former capacity. The Sparrows Point plant is being developed by the Bethlehem company as a complete steel producing unit.

The Bourne-Fuller Company, Cleveland, Ohio, is perfecting plans for the early construction of a new 10-inch bar mill at its Union mills, designed to replace existing 8-inch and 9-inch units. The new plant will be equipped to manufacture bars from ¼ to ¾-inch sizes, or substantially the same range of output as provided at the present plant. It is expected to have the new unit in service as soon as possible. The company will also carry out an improvement program at its Upson steel works, consisting considerably in the installation of additional electrical equipment ,including 3,000-kw. motor-generator set, with 4,000-hp. reversing motor for driving the blooming mill; a new turbo-blower to replace present steam blowing engines used for the blast furnace, the new unit to have a capacity of 33,000 cubic feet of air per minute; a new 4,000-kw. turbo-generator with auxiliary equipment at the power plant, as well as other miscellaneous apparatus.

* * *

The Capital Iron Works, Inc., Seventh and Holliday Streets, Topeka, Kan., will soon begin the construction of its proposed new steel fabricating plant on local site, consisting of two main one-story units, 98 by 200 feet, and 50 by 100 feet, respectively, and one-story office, 50 by 55 feet. The new works are estimated to cost about $200,000, with equipment. R. A. Finney, New England Bdg., is consulting engineer for the project.

* * *

The Carnegie Steel Company, Pittsburgh, Pa., has begun work on a new addition to its by-products plant at Clairton, Pa., anthorized a number of months ago by the parent organization, the United States Steel Corporation, with ultimate cost estimated at $25,000,000. A contract for a portion of the equipment has been let to the Koppers Company, Pittsburgh, and other awards will be arranged with different interests. The installation will include six additional batteries of 61 ovens each; the oven units, individually, will cost about $15,000. A new by-product house will be constructed and other structures erected.

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The Union Iron Works, Los Angeles, Cal., have authorized the immediate construction of a new steel fabricating plant at the junction of Slauson and Compton Avenues, and Jaboneria Road, where a tract of land has recently been acquired. The main unit will be one-story, 150 by 450 feet, and will be supplemented by additional structures at a later date. A 10-ton electric traveling crane operating on a runway 80 feet wide will be installed. A material yard will be established, 120 by 750 feet, as well as a distributing yard, 48 by 750 feet, and shipping yard, 90 by 550 feet; both of the last noted yards will be provided with traveling cranes. The present plant of the company has a capacity of about 1,200 tons of structural steel per month and the new works have been designed to give about 50 per cent increase in this output. Robert Miller is general manager.

* * *

The Weirton Steel Company, Weirton, W. Va., is continuing its expansion program and has recently broken ground for another unit at its plant, consisting of a new strip mill estimated to cost close to $5,000,000, and which is slated for completion in March, 1927. The plant will be located between Lee Avenue and the present strip steel plant. It will comprise a one-story furnace building, 80 by 150 feet; slab yard, adjoining, 100 by 400 feet; hot mill building, 84 by 1110 feet, with the mill unit of eight stands of horizontal rolls and three edging rolls located at one end of the structure; pickling department paralleling the hot mill; cold mill building, 100 by 500 feet, with annealing department adjoining of like size. The new plant unit will also include a complete steam-operated electric power plant, and practically all of the machinery will be electric-driven. A shipping department will also be constructed of size 100 by 500 feet. It is currently reported that the next unit to be added at the plant will be a tube mill. The entire program will cost approximately $15,000,000, and will provide the company with a strip steel, tinplate mill, blast furnace, steel mill, strip sheet mills, coke plant and auxiliary structures.

* * *

The Rockaway Steel & Iron Company, Rockaway, N. J., recently formed with a capital of 1,000 shares of stock, no par value, will take over the former local plant of the International High Speed Steel Company. The property, previously owned by the Rockaway Rolling Mill, has been purchased by the new organization which is composed largely of interests heretofore identified with the last noted company. Plans are under way for extensions and improvements in the plant, including the installation of considerable additional equipment. The new company will convert the works for the production of reinforcing bars, cross-arm braces and kindred iron and steel products, as well as merchant bars made largely from old steel rails. Edward Enhlers is president of the new organization.

* * *

The Midwest Steel & Supply Company, Bradford, Pa., has plans under way for the construction of a new one-story addition to its steel works at East Bradford, to be 47 by 100 feet, estimated to cost close to $50,000, including equipment. J. Hillstrom is general manager.

* * *

The Southern Wire & Iron Works, 55 Martin Street, Atlanta, Ga., manufacturers of structural and ornamental iron products, iron railings, etc., is said to have tentative plans under advisement for a new addition to its plant on site, 200 by 200 feet, reported to cost in excess of $70,000, including equipment.

* * *

The Cadillac Malleable Iron Company, Cadillac, Mich., has preliminary plans under way for extensions and betterments in its plant for considerable increase in output. The work will consist of one or more new buildings and the installation of machinery to cost in excess of $200,000. The company is arranging a security issue of $250,000, to provide funds for the project.

* * *

The American Sheet & Tin Plate Company, Pittsburgh, Pa., has authorized plans for extensions in its mills at New Castle, Pa., including improvements in existing structures. It is proposed to install additional equipment. The entire project will cost more than $300,000.

Eagle Oil & Supply Company of Boston have been appointed distributors for Quigley Furnace Specialties Company, Inc., of New York, covering Eastern Massachusetts and Rhode Island, for all Quigley products including Hytempite, acid-proof cement, Quigley refractory gun, and Triple-A protective solutions, etc., which will be carried in stock.

* * *

Offices of the American Boron Products Company, Inc., manufacturers of alloying metals in shot form, have been moved from Reading, Pa., to Buffalo, N. Y. Increased facilities are offered at the Buffalo plant, located at Ramsdell and Elmwood Avenues.

COMING MEETINGS

September 20-24 — American Society for Steel Treating. Annual Convention and National Steel and Machine Tool Exposition at Municipal Pier, Chicago, Ill. W. H. Eisenman, 4600 Prospect Avenue, Cleveland, Ohio, secretary.

* * *

Sept. 27-Oct. 1—American Foundrymen's Association. Second international foundrymen's congress, Detroit. R. E. Kennedy, secretary, 909 W. California Street, Urbana, Ill.

TRADE PUBLICATIONS

Pulverized Fuel—Unit pulverizers for industrial furnaces manufactured by the Combustion Engineering Corporation, New York, are described in a catalog recently issued. Construction, operation and application of the pulverizers are given.

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Car Retarders—Webster Manufacturing Company, 4500 Cortland Street, Chicago, issued a bulletin describing its car retarder for handling cars under a tipple. Operation of the device is described and a plan drawing gives its dimensions.

* * *

Coal Crushers—Crushing lump or run-of-mine coal to stoker sizes is discussed in a recent bulletin of Webster Manufacturing Company, 4500 Cortland Street, Chicago. Single and double roll crushers are described and illustrated, and prices, dimensions and capacities tabulated.

* * *

Steel Grating—Tri-Lok Company, 5527 Butler Street, Pittsburgh, has published a broadside explaining the construction of its steel floor grating. An unusual locking system is employed, which is fully discussed.

* * *

Flexible Shafting—An illustrated booklet showing the application of flexible shafting equipment for industrial purposes recently has been issued by the R. G. Haskins Company, Chicago.

* * *

Cranes and Hoists—Electric traveling cranes and hoists are described in a catalog issued by the Milwaukee Electric Crane & Mfg. Corporation, Milwaukee. Features of construction are shown and typical industrial installations are included.

Power Apparatus—Cutler-Hammer Manufacturing Company, Milwaukee. "Industry's Electrical Progress," an excellently printed booklet of 36 pages, bound with cardboard, telling of the progress made in the past two decades in the development of motors control apparatus. The book is designed to prove that the advantages which electric power brings to industry lie in the effectiveness with which electricity is utilized. A number of practical problems arising from the installment of power-driven equipment are answered in the concluding pages.

* * *

Electrical Apparatus—General Electric Company, Schenectady, N. Y. Bulletin GEA-135, describing the company's standard-panel switch-boards, designed to handle non-grounded currents at 2300 volts. Bulletin GEA-185, describing 2, 3 and 4 pole manual contactors for currents of 600 volts or less. Bulletin GEA-319, describing the company's spearable post-type insulators for outdoor station equipment designed for use on ratings up to 220,000 volts. Bulletin GEA-399, describing switchboards with either oil or air circuit breakers for use in small generating statons.

* * *

Regulators—Westinghouse Electric & Mfg. Company, East Pittsburgh. New information on regulators for generator-voltage control in 55-page, special publication, No. 1734. An automatic regulator consisting of an electrically operated rheostat and its control equipment, recently perfected, is described, and the text on special regulator applications brings out the important qualifications and functions of speed regulators and power factor regulators. The publication also contains discussions of regulators for d.c. generators, vibrating-type regulators for a.c. generators, application of d.c. generators to exciter service, compensation for voltage-drop, and parallel operation of regulators.

* * *

Zeolite Water Softener—Graver Corporation, East Chicago, Ind. Bulletin 509 of 12 pages describes a water change since 1920, and for that reason comparisons made then are not applicable now. As an instance of this, central station operations have changed so that not over 60 per cent of the coal required per kwhr. is now used, as compared with the amount required just following the war period.

Although not having figures available, he was of the opinion that an electric drive at Steubenville, figuring 14 lb. of steam per kwhr., would call for 200 lb. of steam per ton of steel rolled in place of the 318 lb. of steam per ton as was actually obtained by the use of the uniflow engine. Since the war period over 100 old steam engine mill drives have been replaced by electric motors.

W. Stoop stated that the investment cost of the steam-engine mill drive at Steubenville was $750,000 less than would have been the initial expenditure for electric drive.

Martin J. Conway, the author, in replying stated that a test made at Sparrows Point on an electrically driven mill showed a power consumption of 17 kwhr. per ton produced. Assuming the power cost at ½ cent per kwhr., the cost per ton rolled would be 8½ cents. Considering the engine drive at Steubenville, using a steam consumption of 400 lb. per gross ton of metal rolled and a steam cost of 22 cents per 1,000 lb., fuel cost at Steubenville would be 8.8 cents per ton of metal rolled.

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The Blast Furnace and Steel Plant

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